IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

BALLY MANUFACTURING CORPORATION, a Delaware corporation,

Plaintiff/Counterdefendant,

vs.

D. GOTTLIEB & CO., a corporation, WILLIAMS ELECTRONICS, INC., a corporation, and ROCKWELL INTERNATIONAL CORPORATION,

Defendants/Counterplaintiffs.

Docket No. 78 C 2246

Chicago, Illinois
January 3, 1984
10:50 a.m.

VOLUME I-A
TRANSCRIPT OF PROCEEDINGS
BEFORE THE HONORABLE JOHN F. GRADY

TRANSCRIPT ORDERED BY: MR. JEROLD B. SCHNAYER
MR. MELVIN M. GOLDENBERG

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THE CLERK: 78 C 2246, Bally Manufacturing v. Gottlieb, for trial.

THE COURT: Good morning, counsel.

MR. GOLDENBERG: Good morning, Judge.

MR. TONE: Good morning, your Honor.

MR. LYNCH: Good morning, your Honor.

THE COURT: Before we get under way, it might be helpful to you for me to tell you what our schedule is going to be this week.

We will go until 12:30 or so and resume at 2:00 o'clock and go until about 5:30 or so.

Tomorrow morning we will go from 9:30 until 12:30.

On Thursday I have an appointment at the hospital. I have been having some health problems, and I have been having to go in and out for various tests, and I have one at 9:00 o'clock. So I don't think we can realistically expect to get started here before about 11:00 on Thursday the 5th. We will go until 12:30, back again at 2:00 until 5:30.

Then on Friday again we will go 9:30 to 12:30 and then 2:00 until 5:30.

I am emergency Judge this month and, therefore, there could be interruptions, but we will keep our fingers crossed and hope that they are minimal.

All right.

MR. TONE: Your Honor, there are a few housekeeping matters that we need to take care of before we have the opening statements.

We have subpoenaed a number of witnesses, who are here, and we request that the Court instruct the witnesses that they are excused subject to being notified by counsel when we are ready to call them.

THE COURT: All right, all witnesses who have been subpoenaed to testify in this case will have your subpoenas continued generally. I request that you respond to counsel's telephone call and appear to testify when you are requested to by the party who subpoenaed you. This will be convenient for you and avoid your having to wait around, and we will do our best to make sure that any inconvenience involved is kept to a minimum.

Are there any problems or questions that any of the witnesses have?

All right, then those -- yes, Mr. Lynch?

MR. GOLDENBERG: Judge, I would ask with respect to the Williams employees -- and Mr. Tone and I have spoken of this matter -- that they make every effort to give us as much advance notice as possible.

THE COURT: I am sure they will.

MR. TONE: And I have told Mr. Goldenberg we would.

THE COURT: Yes.

MR. LYNCH: With respect to the same matter, your Honor, there are several witnesses that have appeared on plaintiff's exhibit list that are from Rockwell in California.

The depositions of those witnesses were taken and no cross-examination was undertaken at that time because typically they are under my control.

I have asked counsel when those witnesses are to be available; and because of the distance that has to be traveled, I would appreciate as much notice as possible.

I am going to object, your Honor, to the admission of the depositions, because I will bring some of these witnesses here. And I've told counsel this several weeks ago.

THE COURT: Well, we'll deal with the admissibility of the depositions at such time as it's offered.

And as far as the convenience of the witnesses are concerned, we'll do whatever is necessary to make sure it's not a problem.

MR. TONE: Very well.

Your Honor, the re-issue patent has come since the complaint was amended, and we ask leave to amend the complaint to substitute the re-issue for the original patent.

THE COURT: All right. Is there any objection to that?

MR. LYNCH: No, I have no objection, your Honor.

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In connection with that, however, there is a small housekeeping matter in our response.

MR. TONE: And I think counsel have talked about that, and we have no objection to your filing an amended pleading.

MR. HARDING: What it is, your Honor, we noticed a typing error in the Defendant Gottlieb's amended answer. It omitted the first four subparagraphs of the prayer as it was originally typed in Gottlieb's answer.

And we would like those four paragraphs to be reinstated.

THE COURT: All right.

MR. KATZ: No problem.

THE COURT: That motion is allowed.

MR. TONE: Next we have a scheduling matter, your Honor.

There are a couple of evidentiary depositions that were discussed in the telephone conference between the Court and counsel a few days ago.

We have contacted Mr. Mike Rogers, and understand that the only time he will be available is Saturday morning, next Saturday morning, in California.

We could attempt to do that by telephone. Perhaps it would be safest to send two lawyers out there to take the deposition.

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The purpose of the deposition will simply be to confirm a declaration Mr. Rogers filed in the Patent Office, which of course is not admissible in this Court, absent stipulation; but the subject of the deposition will be the statement he filed in the patent office.

THE COURT: Is there a desire to cross-examine Mr. Rogers?

MR. LYNCH: I think there may be, your Honor.

THE COURT: Well, if there's not essential cross-examination, or if the cross-examination is minimal, so that there's no great credibility issue involved, perhaps you could do it by telephone.

I think a trip to California by two lawyers could be justified only if this is a real significant issue in the case and there is a credibility question.

MR. LYNCH: I will have to undertake to consider that with Mr. Goldenberg.

MR. GOLDENBERG: Judge, I do believe there is a credibility question with respect to this witness. I'll not go into that now, but that issue is there.

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MR. TONE: All right. Then I guess we have the problem of scheduling him. We would like to do that Saturday morning. If we have to go out there, we'll have to go out there.

Also, we would like to get the deposition and exhibits with respect to the Black Knight on Saturday. That's the infringement matter.

And the reason we want that is so that that material will be available when our expert on the subject of infringement testifies, which we hope will be next week.

MR. GOLDENBERG: We would be offering Mr. Paul Dussault, a Williams employee, who is subpoenaed in this case.

I would -- subject to Mr. Dussault's availability, which I'll ascertain before the day is over, I see no problem with that.

MR. TONE: All right. That may mean we'll have to divide forces, if we're going to do both those things on the same day, but we'll work that out.

MR. GOLDENBERG: Don't do it on Sunday. The Redskins are playing, and I have to watch that.

MR. TONE: All right, we'll not do it on Sunday.

THE COURT: I don't know whether they're going to be playing, or just simply waiting to see whether anybody shows up.

(General laughter.)

MR. TONE: I think that is everything we need to take up with your Honor now.

There are a few things to discuss with counsel, and I hope we can work those out without bothering the Court.

MR. LYNCH: I think so, your Honor. But I have several other matters.

First of all, there has been in this case from the outset a rather stringent confidentiality order and secrecy order with respect to documents.

In order to prepare many of the documents have been attorneys' eyes only. I think that at this point in time the order ought to be, except for financial information, but insofar as technical information, that the documents should be used only for purposes of the trial. I'm willing to live with that.

THE COURT: All right, that will be the order by agreement.

MR. LYNCH: And the last matter is that defendants Gottlieb and Rockwell would like to invoke the rule, your Honor.

THE COURT: All right. All witnesses who are going to testify in the case will be excluded from the courtroom except that each defendant may have a representative present during the trial.

MR. GOLDENBERG: Judge, I agree with Mr. Lynch's

invoking of the rule.

I do think, out of fairness to both parties, and helpful to the Court indeed, if each of the parties was permitted to have present in the courtroom, while others were testifying, the technical expert they were prepared to call.

THE COURT: That's all right with me.

MR. TONE: That's all right with us.

MR. LYNCH: That's acceptable to me also, your Honor.

THE COURT: Fine.

MR. GOLDENBERG: I would at this time like to introduce to the Court Arthur Handler. Mr. Handler is a member of the bar of the State of New York and a partner in the firm of Golenbock and Barell in New York City and is general counsel for William Electronics.

And I simply want to introduce him to the Court at this time --

THE COURT: Good morning, Mr. Handler.

MR. GOLDENBERG: -- so that his presence at counsel table may be understood.

My next point is truly a housekeeping matter: Sometime later on this morning we would be interrupting proceedings to bring into the courtroom two pinball games, and there may be a five or ten-minute interruption --

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THE COURT: That is fine.

MR. GOLDENBERG: -- if that is all right with you, sir.

THE COURT: We can handle that.

MR. GOLDENBERG: Thank you.

MR. TONE: Back to the subject of experts, your Honor, in a brief conversation aside with Mr. Lynch, he indicated that they would not agree to have Professor Kayton in the courtroom while the evidence was coming in. So that is a matter that I will have to take up with the Court.

THE COURT: Is he your technical expert?

MR. TONE: He is one of two technical experts. We have an expert --

THE COURT: Is there any objection to having two?

MR. LYNCH: Well, your Honor, Professor Kayton is a practicing patent law expert who is going to testify about what happened in the Patent Office.

MR. GOLDENBERG: He is not a technical expert, Judge.

MR. LYNCH: Those proceedings are closed, and, your Honor, I think that the appropriateness of Professor Kayton testifying about patent law or patent practice is fine insofar as the Court wants to hear it and rule with respect to objections, but I don't feel that it is necessary or appropriate that he hear the testimony of others in this case.

THE COURT: What does it hurt?

MR. LYNCH: Well, your Honor, it enables him to talk about the evidence in this case and compare it to the Patent Office evidence by weighing it in his mind.

Now, if Professor Kayton is going to testify about what occurred in the Patent Office and if the evidence here is different than what occurred in the Patent Office, I want to be able to examine Professor Kayton and get his response based on that written record. I do not want to have Professor Kayton in an expert capacity become argumentative or to shade his testimony one way or another based upon the evidence he hears here and your Honor can understand that can happen.

THE COURT: Isn't this true of any expert? I mean --

MR. LYNCH: As far as technical experts --

THE COURT: It is equally true of a technical expert. I mean, they may not be preparing Patent Office from this trial, but surely they learn something in the course of sitting here. I suppose the idea is that they do learn something. You want to hear what they say about what is going on at the trial.

Isn't that what Professor Kayton is going to be --

MR. KATZ: Yes.

MR. LYNCH: If Professor Kayton is here to tell us

what is going to happen in this trial, your Honor, then I don't believe that is appropriate testimony.

THE COURT: Well, I spoke loosely. I have had such testimony in other cases. I understand the purpose of it.

I don't really think there is a practical difference between having him sit here, on one hand, and having him hear about it over dinner on the other.

MR. LYNCH: I believe in the invocation of the Rule; that the Court ought to instruct the witnesses not only that they cannot sit here, but they may not read the transcripts and that they may not know the substance of the testimony.

THE COURT: Well, it depends on what they are going to be testifying about.

MR. LYNCH: Professor Kayton is going to testify about what happened in the Patent Office, your Honor. If he testifies about any more than that, then he is testifying about what is occurring at this trial.

THE COURT: All right, Mr. Katz, let me hear you.

I am having difficulty here because I am not sure just what the issue is that he is going to testify about.

MR. KATZ: Professor Kayton is also going to testify based on testimony of technical witnesses, such as Dr. Schoeffler, assuming credibility of a witness, the relevancy or considerations with respect to the prior art references that were considered in the Patent Office.

Professor Kayton has in fact a background in engineering and mathematics and computers from Bell Laboratories.

THE COURT: One of the things that I consider here is time, and it is a lot quicker from my standpoint to have a witness sit here and listen to it and just have him answer yes to the question, "Have you heard the testimony," than to go through the laborious process of acquainting him with what the testimony has been by the way of a hypothetical question, or however you might do it.

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Now, I want to deal with substance here, and unless there is a real substantive element of prejudice, I want to do it the quick way, and it seems to me the quick way is to have him sit here and listen. Then you can on cross examination, Mr. Lynch, make whatever you wish of the fact that he has been sitting here.

MR. LYNCH: Professor Kayton, your Honor, experts in many, many cases. He is an extremely well-known expert, and I believe he is an advocate from the witness stand.

THE COURT: Well, I have never seen one of these lawyer witnesses in a patent case who was not an advocate. That is why they come here.

MR. LYNCH: I understand that, your Honor, but when you let another lawyer listen to the entire matter and get on the witness stand, I believe I am prejudiced.

I would like to point out to the Court that Rule 615 indicates that witnesses shall be excluded, and it is the burden of the other party to prove it is absolutely necessary to their case.

Now, Professor Kayton --

THE COURT: Well, absolutely necessary, I think, is probably too strong a phrase.

MR. LYNCH: Necessary.

THE COURT: Nothing is absolutely necessary. You can get by on one lung if necessary.

MR. LYNCH: Not without both, your Honor.

THE COURT: I am thinking of kidney.

MR. LYNCH: The word in the rule is essential to the presentation of the case, your Honor.

Your Honor, I have no objection to Professor Kayton listening to Mr. Schoeffler's testimony, the other expert's testimony, but all of the testimony --

If he listens to all of the testimony in the case and then is permitted to get on the stand and testify, it seems to me, your Honor, that we wind up with a potential analysis of the Patent Office record shaded by what has occurred in the case.

THE COURT: Well, let me ask the plaintiff this. Do you gain more by having Professor Kayton sit here and hear everything and thereby open the door to the argument that Mr. Lynch makes concerning his credibility; then you lose by having his testimony subjected to that argument? If he does not sit here and if we apply the rules so that you cannot tell him what has been going on here, it seems to me that the value of his testimony to the Court may well be enhanced over what it would be if he were given the opportunity to shade that Mr. Lynch suggests that he would have by sitting here.

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MR. TONE: Well, if your Honor has any concern about that, our option, of course, would be to present him in such a way that he would have the maximum credibility.

My own feeling about it in a patent case is you normally have the expert, the legal expert, as well as the technical experts in the courtroom, and it is much faster and more expeditious and efficient to do it that way. But I guess I would think that as between having the witness lose any credibility and having to do it the long, hard way, I would prefer the latter.

THE COURT: I cannot guarantee you that he would not lose something, and it may well be that he would not lose an iota of credibility, but I cannot predict one way or the other.

MR. KATZ: I think it would be much more efficient to be asking the questions based on the testimony --

THE COURT: I do, too.

MR. KATZ: -- rather than to try to struggle --

THE COURT: There is not the slightest doubt.

MR. KATZ: -- which themselves may be attacked.

It is much faster and efficient to have him here and just go straight through it and let the Court decide itself based on the cross examination whether there is any disability.

THE COURT: It seems to me that if the word is

essential that it would be difficult to support the proposition that his presence here is essential. Convenient, yes; perhaps sensible, yes; but essential, probably no.

So I think I will exercise my discretion, if I have any on this -- I assume I do have some -- to exclude Professor Kayton as far as those matters as to which Mr. Lynch has raised an objection. Apparently there are other matters as to which you do not have an objection.

MR. KATZ: No objection to Dr. Schoeffler. He can sit here during Dr. Schoeffler's testimony. That is our technical expert.

THE COURT: All right.

MR. GOLDENBERG: I have nothing else, your Honor.

THE COURT: Okay.

MR. TONE: We have nothing further, your Honor.

THE COURT: Let's have opening statements.

MR. TONE: May it please the Court?

THE COURT: Mr. Tone.

OPENING STATEMENT ON BEHALF OF THE PLAINTIFF

MR. TONE: This opening statement will be very brief because we have filed with your Honor a rather lengthy trial brief.

THE COURT: I have not read the trial brief yet, but I will within the first few days of the trial. If the

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defendant files anything, I will read that within the first few days after I receive it.

MR. TONE: Very well.

The defendants have served us this morning with a short trial brief. So both sides have filed trial briefs. Our position is stated in considerable detail in that brief, and I will not attempt to duplicate that detail in the opening statement.

The invention is the first practical electronically controlled pinball machine. It uses a matrix multiplexing system for interfacing a microcomputer to a pinball game playfield and its switches and display elements while controlling various ball activity -- ball-activating mechanisms in response to the microcomputer in real time, and we will talk about that concept in much more detail during the testimony of the first witness, Mr. Frederiksen, who is one of the inventors.

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The inventors are Mr. Frederiksen and Mr. Nutting.

Mr. Nutting, David Nutting, was educated as an industrial designer and was a designer of electromechanical arcade games.

In 1973 he was director of game development for a small company in Milwaukee called Milwaukee Coin Industries.

He hired Jeffrey Frederiksen in 1973, first, as a part-time consultant and later in that year in October, late October, as a full time employee.

Mr. Frederiksen's field was electronics, and he had had training in computers.

Mr. Nutting had been thinking about developing a pinball machine for several years. Milwaukee Coin Industries did not produce pinball machines, but they did produce and sell other arcade games.

The testimony will show that Mr. Nutting wished to do this because the pinball game was the staple of the arcade game industry, and unlike other games, it was not subject to whims and fancies, and it had a relatively long life in the arcade.

Mr. Nutting also had in mind that it would be highly desirable to have a universal game system, a game system that would be applicable, not only to pinball games,

but to other non-video games.

He recognized that because his company was a small company without much in the way of financial means, he would have to develop a design for a pinball game that enabled it to be built cheaply and easily with facilities that Milwaukee Coin had inhouse, and that would have required something, he felt, other than the conventional electromechanical game.

When Mr. Frederiksen came to work, he was told to investigate the possibility of using an electronic system to replace the old electromechanical system for pinball games.

In the ensuing months, Frederiksen, working with Nutting, developed the matrix multiplexing system for mating the pinball game and the microcomputer, which is the subject of the patent in suit. In order to accommodate -- in order to achieve this, it was necessary to deal with the harsh electrical environment, the noise environment, in which the pinball machine must operate.

The invention was reduced to practice, the evidence will show, by September 26, 1974, at which time it was shown to Bally.

Before that Milwaukee Coin Industries in June of 1974 went out of the game manufacturing business, and Nutting and Frederiksen moved to adjacent quarters but

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continued their work which ultimately led to the development of the invention, which completed the invention that ensued, and it led to the development of the working prototype.

So at the time they showed the machine to Bally, they were operating under the name David Nutting Associates.

In 1976 they moved their business to Arlington Heights, Illinois, and Bally Manufacturing acquired that business in 1977 and with it the rights to the patent in suit.

The patent issued June 6, 1978. This case was filed the same day. Then, as your Honor knows, there ensued lengthy proceedings in the Patent Office pursuant to a re-issue application. Your Honor has heard reports of that proceeding over the years as this case has progressed, or perhaps it would be more accurate to say waited for the conclusion of those proceedings.

Depositions taken in this case were used, filed in the Patent Office, and considered by the Patent Office. A lengthy file has accumulated, which will be before the Court in this case.

A few months ago in -- November, I believe, is the date the Patent Office finally re-issued the patent in suit.

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We are asserting infringement of several claims, which we'll identify. All of those claims were in the original patent and were merely repeated in the re-issue patent, with a single exception:

One of the claims, 95, was previously a dependent claim; but it has been restated as an independent claim, although its elements are precisely the same as they were in the original patent.

I should like very briefly to state the sequence of our order of proof without going into any detail as to the substance of that proof because, as I said, the opening -- the trial brief covers that.

We'll first present the testimony of the two inventors, Jeffrey Frederiksen and David Nutting. They will describe their invention and the development and reduction of the invention to practice.

Second, the witnesses, certain witnesses employed by Bally will testify as to the state of the art. They will corroborate the evidence of reduction to practice and they will establish the commercial success of the invention.

Next, Gottlieb and Williams witnesses will be called on adverse examination to establish the difficulty they had in developing the game, skepticism in the industry with respect to the feasibility of the microprocesser as a

drive -- as the system for operating the pinball machine. There will be at least one witness from Game Plan on the same subjects.

Depositions will be offered to corroborate the inventors, to show the state of the art, and to prove attempt and failure of others, namely Atari and Ramtech. And I think your Honor has heard about that as the deposition evidence was discussed during motion proceedings in the case.

The evidence establishing how the Gottlieb and Williams representative games operate, which of course is necessary for the infringement evidence, will be presented near the end of the case.

Dr. Schoeffler will be our expert on both validity and infringement. And we plan to have Professor Kayton as our final expert testify on the subjects that your Honor heard about a few minutes ago.

That in very brief compass is the opening statement for the plaintiffs.

THE COURT: Thank you, Mr. Tone.

MR. GOLDENBERG: Your Honor, I've just been advised that the pinball games that I had reference to a moment ago are now available.

THE COURT: And you'd like to bring them in?

MR. GOLDENBERG: We would like to bring them in. It will take a few minutes to do that, and set them up.

THE COURT: Go ahead. And let me know when you're ready.

MR. GOLDENBERG: Thank you, Judge.

(There was a brief recess, after which the following proceedings were had herein:)

THE COURT: Mr. Lynch?

OPENING STATEMENT ON BEHALF OF DEFENDANTS GOTTLIEB AND ROCKWELL

MR. LYNCH: May it please the Court, your Honor, as your Honor is aware and has been aware for the last five years, this is a patent case. In this opening statement, because our brief was short, I would like to be slightly more elaborate than the plaintiff in the examination of the evidence that the Court will see and the witnesses the Court will see from the defendants.

I believe that at the conclusion of my statement, Mr. Goldenberg may have some words for the Court. We will endeavor not to make them repetitive, as we will throughout the trial, your Honor.

In this patent case, your Honor did not hear from the plaintiff and your Honor will not see in the plaintiff's brief a discussion of the patent and the claims of this patent, and the reason why your Honor will not see that is because it will be, we believe, an objective of the plaintiff to obscure what the patent says and in particular what the patent claims say.

MR. TONE: May it please the Court, an objection during an opening statement is most unusual, but an opening

statement is supposed to state what the evidence will show and not contain argument.

I observed that rule in mine, and I think it ought to be observed.

THE COURT: Well, this is sort of a borderline case of that, I suppose. If the evidence is going to show that there are problems of patentability here that aren't being focused on by the plaintiff, I suppose it is fair for the defendant to note that in opening statement.

MR. LYNCH: I will --

THE COURT: On the other hand, maybe it is --

MR. LYNCH: I will endeavor not to be argumentative.

THE COURT: -- so close to argument that Mr. Tone's objection has some merit.

So you can bear that in mind, Mr. Lynch.

MR. LYNCH: May it please the Court, your Honor, my point is that defendants will rely as an exhibit, and as an exhibit on which they will put considerable reliance, on the patent and the patent claims. The patent and the patent claims will serve, the evidence will show, to establish -- reflecting on, for example, Claim 1 of the patent, your Honor -- which, of course, will be an exhibit in plaintiff's case.

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The patent will show precisely what the subject matter of the patent is and what the Patent Office said was not patentable.

Two amendments were injected --

THE COURT: Can you move that a little closer to me? I can read it a little better.

MR. LYNCH: Certainly, your Honor.

(There was a brief interruption.)

MR. LYNCH: Two amendments were interjected into Claim 1 -- and Claim 1 is being put before your Honor as illustrative of what occurred in the Patent Office.

The amendments, your Honor will see, as they appear in the printed patent document, are in italics. Deletions appear in the very bold brackets.

There are, as an addition, the fact that the game apparatus originally claimed had a game housing; there's a game surface in the housing; and down at the bottom one will see that the processor is in the housing. That is the box in the pinball machine.

Those particular amendments were necessary in order to salvage Claim 1.

It is fair to say, your Honor, there are other claims in issue which eliminate the housing, and otherwise contain everything in Claim 1.

Secondly, a limitation which became introduced

into all of the claims that didn't originally have it in the Patent Office proceeding, the evidence will show, is this limitation of the fact that the game is a surface projectile game.

Your Honor will notice the original claims called for a game apparatus. Now, we have a game apparatus of the type that has to have some type of game surface with a surface projectile.

The point, your Honor, is, the evidence will show, although this Court is not bound by what the Patent Office held was valid, and this Court will look at that patent from a validity standpoint and apply the statutory criteria to it.

We do know what is not patentable as a result of the Patent Office action. And that is a game apparatus having all of the computerized business that we will get to later, that does not have a surface projectile. That does not have a surface projectile.

Defendants will, in part of the plaintiff's case, examine the inventors. And the inventors, Mr. Nutting and Mr. Frederiksen, will testify as they testified during discovery, about the early efforts that they undertook that resulted in the patent in suit.

Placing before your Honor a placard which later will be identified as Defendants' Exhibit 2-J,

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generated by the inventors: Their concept, the evidence will show, was to generate a brain, a Bally brain, is what they called it for promotional purposes. They're trying to sell it to Bally.

But that Bally brain, your Honor, was going to be a microprocessor type system that would control a pinball game, a jukebox, a vending machine, a gun game, a bowling game, a driving type arcade game.

Your Honor will notice, and the evidence will show, that the game, such as the arcade game, the gun game, the vending machine and the jukebox involve no surface projectiles.

Pinball does indeed involve a surface projectile. Bowling perhaps involves a surface projectile, throwing something down an alley and attempting to knock down pins to --

MR. TONE: May I interrupt for a minute?

I had noticed that our first witness is still in the courtroom. I hadn't noticed it until --

MR. LYNCH: He can be here. I don't believe the rule is invoked for opening statements.

MR. TONE: I don't think it is, but I wanted to raise it, since I just noticed him.

THE COURT: All right.

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l right.

MR. LYNCH: The point, your Honor, is, the evidence will show that what a microprocessor is, is a device that takes input and creates intelligent outputs.

In a vending machine one walks up and sees the cookies one desires behind the glass. By putting in the right amount of money -- and switches detect that -- pushing the right button, one manages to get a response from that vending machine that will kick out the cookies one desires into the tray.

Inputs of switches giving outputs.

In a jukebox the same situation exists. Coins are placed in; the machine must recognize how many plays are obtainable from that number of coins; and one selects Sinatra or The Who, and plays it.

Arcade games, similarly, to keep, as in a driving game, to keep the car on the road, there is a mechanical way of sensing how agile the player is with respect to the steering wheel, that will connect or disconnect switches of various types, and the score, or a display relating to the skill of the player will be displayed.

The gun game, the same way: A gun is moved. There are devices that have been used in arcades that close various switches, that determine where that gun is pointed, and you get a score.

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The point, your Honor, is that all of those devices use switch inputs and outputs; the outputs are intelligent with respect to the inputs.

A calculator, the evidence will show, is very much the same: We turn it on; and when I hit an 8 here, the calculator displays an 8 on its display.

Switch inputs giving an output.

A pinball game and a surface projectile game are very similar, your Honor.

We have here two pinball machines that will be introduced in evidence, Hot Tip games by Williams. These games, the one on the left, of your Honor's left, is an electromechanical game; the one on the right is a microprocessor controlled game.

The effort has been made to make them as near to identical as possible. In fact, there are some minor scoring differences. When you roll over some things on one game, you get more points than the other. That's just because the game designer decided it would play better that way.

But, once again, in a pinball game, with my finger, an input of hitting the bumper bumper device produced an output of 10 points, an input produced an output of 10 points.

If I go to the second game, and its input

produces an output of 10 points -- or, a hundred points, rather.

The same situation exists with the ball. What the ball does when it is about the playing field, it hits this same bumper. It hits the bumper and activates it the same way my finger does.

Once again the game designer decides how many points will be displayed when the skill of the operator manages to have the ball intersect or hit all of the various members on the playfield.

Same as this here (indicating.)

The audio effects are slightly different, another game design feature, but once again we can see that a pinball game with the surface projected is at least, the evidence will show, highly analogous to a device such as a calculator, where inputs in the form of finger-actuated switches produce outputs, similar also to devices such as juke boxes, vending machines, arcade machines, and gun machines, where various closure of switches for amusement, for food, or for music will produce an intelligent and expected output.

That is the role of a microprocessor. Microprocessor functions are to assemble inputs and produce some type of intelligent -- when I say intelligent, as far as the user is concerned, he is obtaining as a result of his inputs the desired output, on a calculator or on any type device.

The pinball games then are very similar.

When we come then, your Honor, to the claims in

suit, we look at precisely what is the invention here, and the evidence will show with reference to, for example, a claim marked as 52, the evidence will show that the large portion of this claim has to do with only prior art aspects of pinball.

The Court is requested to just follow briefly in Claim 52.

I will point out, your Honor, that Claim 52 is not nominally in issue, but three other claims, 53, 54, and 55, are dependent on Claim 52. They are very short, and they do slight modifications to it, so there will be reference to Claim 52 and for these purposes, your Honor, we can focus on 52.

"A pinball game including a digital processor, which has a programming means for programming the processor..."

Processors do have a programming means. There is no particular kind stated.

The evidence will show, without going through this, that in essence everything above the last four lines, beginning, "...the game further comprising," the evidence will show that virtually all of that, if not all of that, is merely a statement of a microprocessor-controlled pinball machine.

It doesn't say how to do it. It in essence says how about having a pinball machine controlled by a

microprocessor.

We get down to the last four lines, and the evidence will show that here is where supposedly the invention resides: "...the game further comprising multiplexing means for cyclically enabling at least some of the elements to perform their associated functions."

In order to approach what that means, your Honor, I will have to go into briefly a very elemental discussion of what a microprocessor is. The evidence will show and, indeed, it will be developed from the inventors in this case that a microprocessor -- and I am showing it as a box -- is a device that has a limited number of wires or lines in which you can input information. Typically, the microprocessors which were involved early in the episodes that your Honor will hear in the evidence had four, for example, arguably five, but on the order of four or five lines to input information.

If one had to monitor more than four switches-- if one had only to monitor four switches, one could put one switch on each line and say: Okay, microprocessor, when I close this switch, you will know which one it is because of the way I have programmed you, and this one and this one and one. But if there are eight switches or a multitude of switches, such as might exist in a gun game, a vending machine, a juke box -- a juke box that has a whole body of switches --

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one has to undertake to look at the switches in some timed fashion.

I am going to look at the switches and then look at them again, and I will look at them in an order and determine if they have been tripped because I only have four lines to look. So we will look and scan the switches.

When one understands -- and the evidence will show, your Honor, that a microprocessor can perform 100,000 odd functions per second -- these are the prior art microprocessors -- 100,000 odd functions per second. One will understand that perhaps we can have this microprocessor look at the switches repetitively several times a second, many times a second; if we have only 50 or a hundred switches, many times per second, and be able to detect a switch closure and process that information.

9-2

That technique, the technique by which a microprocessor takes the time available to it and divides it so that it will look at its various switches in various segments of time is multiplexing. The evidence will show that that is multiplexing.

The evidence will further show that pinball games represented what microprocessor engineers, electronic engineers, and design engineers recognized as an ideal adaptation of microprocessors. Specifically, here we have a host of inputs tied to game rules to produce an output. This trip switch, when you get the ball over on this side, gives you a hundred points. That input had to give that output.

Consequently, long before the patent in suit, advertisements came out in magazines such as by Intel: "From electronic games to blood analyzers."

Promotion of microprocessor introduced for the very first time in late 1971, available in any significant amount in '72 and '73. We are talking about 1973 and '74 as the time period of this invention.

More than a year before the patent in suit, Intel says, "What can we control?" --"Mass transit equipment, reservation systems, cash registers, inventory computers for fast food restaurants, process controllers, electronic test instruments, and even pinball and slot machines." Even pinball and slot machines can be controlled.

Further, in the same advertisement on the opposite page:

"Finally, take a look at the new video games, pinball machines and slot machines. A microcomputer makes them more fun" -- to play -- "more fun and imaginative."

At the same time the evidence will show individuals, particularly Mr. Ed Lee and Mr. Matt Biewer had a company in California that did more than merely -- well, that offered microprocessor systems, microcomputer systems, and they had a brochure that came out in 1973 well in excess of a year before the invention.

Mr. Biewer and Mr. Lee will testify about this brochure. "It is everything you need to get into the game." They were in the business of microprocessor systems.

Here we see a pinball machine. They talk about the potential uses as card readers, pinball machines, ROM programmers, medical electronics, test equipment, data terminals, and POS systems.

So, indeed, when we looked, your Honor, at Claim 52, the combination, the mere combination, of a microprocessor with the pinball machine was a classic marriage of the inputs to outputs, intelligence, if you will, that a microprocessor can bring to bear on an application.

The evidence will show further that there were more than odds if in response to the Intel ad one were to

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obtain the Intel literature and manuals and try to determine how does one go about designing something like this -- one reads things such as this in what I am showing the Court from the INtel manual. "When the number of input lines is insufficient, multiplexers must be added."

Multiplexing, if you have to get 16, 18, 142 switches, into a microprocessor so it will realize and understand all of those inputs, then multiplexers must be added.

T10

Your Honor has already seen that multiplexing means is specified in the latter part of Claim 52.

I showed your Honor the first page of the prologue brochure. The second page of the prologue brochure, the front page of which showed a pinball machine, on the second page they say, "We have three microprocessor systems," this one (indicating), one part, one board, two boards, three boards (indicating.)

Here (indicating) we have a system, which illustrated as the general architecture of that in the upper right portion of their brochure, that effectively is, that effectively is a multiplexing system. It indicates that keyboards, various devices, can be used here, and in essence the evidence will show it is a disclosure of multiplexing.

Indeed, your Honor, the evidence will show that precisely what happens in a calculator is multiplexing. We have on the calculator that I have 24 inputs. Those 24 inputs are scanned and looked at, and back in 1971 and '72 and '73 that was the way that inputs from a calculator, the finger-operated switches of a calculator, produced the output.

To go through the remaining and rough order of the witnesses in defendants' case, I will touch only on one witness from Williams, that being Mr. Steve Kordek. Mr. Steve Kordek and Mr. Alvin Gottlieb, both gentlemen with decades of experience in the pinbaill industry, will testify

to the Court and give the Court evidence about the history and background of the pinball industry.

In this case, your Honor, there are three companies, Bally, Gottlieb, and Williams, all based in Chicago. They represent not only the backbone but 90, 95, 90-something percent of the pinball industry for the last several decades.

The gentlemen, Mr. Gottlieb and Mr. Kordek, will testify how, as an electromechanical industry, the pinball industry thrived on its manufacturing ability to create complicated electromechanical logic, and that is what your Honor will see in these electromechanical machines, electromechanical logic, switches, solenoids, lights that blink, plastic things, chimes, and devices that will propel the ball around the playfield.

They were able to assemble these extremely, relatively extremely inexpensively, make them relatively easy to service and understood to service, and developed a highly organized distribution system.

This was what the pinball industry was in 1970. It was a service-oriented industry. The arcade dealers had years and years of experience.

The witnesses will establish that the reasons, which will be argued by plaintiff as being inability to make the invention, that the reasons why this invention came along when it did and why, if there was any delay, there was, was

because of inability to assure service of microprocessors at the arcades and because of cost reasons.

Finally, the witnesses will establish that what sells a pinball game is not the microprocessor as such. It is the game features. The game features of a pinball game enable it to be sold.

It is true; the microprocessor gives the pinball designer some advantage in game features, but that is simply because it can perform more functions and perform them very quickly.

Your Honor will also hear from individuals from the same or prior time frames to the time frame in which the inventors supposedly made their contribution. Your Honor will hear from Mr. Ray Holt, a gentleman who worked for a company named Compata in California. Compata was a company that was hired by Intel to educate electronic engineers in the possibilities, potential, if you will, of the microprocessor in the early '70's. Mr. Holt himself undertook to design a microprocessor-controlled pinball game during the period of 1974 and early 1975, prior to the filing of the patent in suit.

T11

When Mr. Holt approached it, did he multiplex? Yes, he multiplexed.

Mr. Ed Lee and Mr. Matt Bieuer will testify about their systems and about how they use, and indeed frequently require that multiplexing be used to be interfaced with a number of inputs.

Your Honor will also hear from witnesses from Atari: Mr. Steve Mayer, Mr. Larry Emmons, Mr. Ed Scnleeter Mr. Steve Bristow.

In the early 1970s Atari was a game manufacturer, a video game manufacturer. But on the horizon came the microprocessors, and Atari undertook a development effort to adapt a microprocessor to pinball.

What did they have to do? They had to buy an electromechanical pinball machine and connect it up.

They did do that. And in doing so, they used something called the development system of the Intel microprocessor, a device called the Intellec.

When an engineer is attempting to program a microprocessor and be sure that the program responds intelligently to the inputs in the desired fashion, he inevitably has to fiddle with it. The Intellec gives him the ability to do so and not fix the chips, so that he puts it in and finds out that he has to take it out again and put in different types of devices.

The Intellec device was adapted to an early electromechanical machine at Atari, and it came out with a cable, because the device was a rather large development device used to control the system.

It was done at Atari's Cyan laboratories, which was their development laboratory, and the device played like a pinball machine.

The device played like a pinball machine virtually a year prior to that the patent in suit was filed.

The evidence from Mr. Mayer, Mr. Emmons, and perhaps Mr. Schleeter and Mr. Bristow, will establish that indeed that machine established for them the feasibility of the prototype.

They were looking for a prototype. They established that feasibility. And they, furthermore, used the multiplexing technique, that same multiplexing technique.

The employees of Atari did not stop. They then created five other machines. Five machines, one of which came to Chicago in the fall of 1974 to the Music Operators of America Show, what is in essence the arcade manufacturers' congress, world congress, held here in Chicago. The device was at the Atari suite and played there.

In late 1974 and early 1975 the device was placed in a pizza parlor.

1-1,3cbRJ

These five devices performed in various fashions. And your Honor will hear from the plaintiffs some evidence indicating that electrical noise was a problem with these devices.

In that connection the Court will be requested to note, and the evidence will establish, A, that an electrical engineer such as Mr. Mayer, Mr. Emmons, Mr. Bristow and others, were well able of handling noise; but, B, noise, an electrical noise, is not a factor in this patent. It is not mentioned in the claims and none of the claims in issue contain any circuitry, any device or any technique which is directed toward noise abatement in a pinball machine.

1-2

-2x,lcbRJ machine

Your Honor will also hear from two other witnesses, one of whom is ill, and we may have -- he was stricken with a stroke not one month ago. He's indicated he may be available for a deposition, and we may have to do that, your Honor.

Mr. Dave Nixon and Mr. John Vurich. These two individuals were employees at a company called Mirco in Phoenix, Arizona.

Mirco was a company that in 1975 had a contact with Mr. Nutting and Mr. Frederiksen. Mirco was the first company that Nutting and Frederiksen tried to develop a microprocessor controlled pinball machine with.

Mr. Nixon and Mr. Vurich will testify for the Court and explain to the Court precisely what was the status of the development: How accomplished was this design, how did it compare in essence to what plaintiffs will indicate was an incomplete or unsatisfactory design by Atari.

There will be testimony, also, your Honor, from individuals at Bally; because, indeed, although Bally is the owner of the patent in suit, it purchased it some years after the operative work occurred.

And indeed, in late 1974 Bally itself undertook to attempt a microprocessor controlled pinball machine. And prior to the time of the filing of the patent in suit

it accomplished a microprocessor controlled pinball machine using multiplexing; using, however, a system that is the subject matter of another Bally patent.

And that second, other Bally patent, later in time than the re-issue patent involved here, that later Bally patent contains the design of the Bally commercial pinball machines that supposedly have created the commercial success that will be relied upon here.

That second Bally design is a design, the evidence will show, your Honor, that was pursued by Bally to the -- well, as an alternative to going the Nutting way.

Bally indicated that, "We would not go the Nutting way," and Nutting was off with the Mirco individuals.

Bally opted to make its own version of a pinball game.

The import of this, your Honor, has to do with the evidence of commercial success. And the evidence will establish that this device of Bally is the device that is responsible for sales. The Nutting way was rejected early on.

Now, Bally acquires the Nutting patent. And the evidence will show that the claims and assertions of marvelous performance by -- of the Nutting device, of the Flicker game, the claims of superlative performance are claims that will be corroborated by Bally.

1-2x,3cbRJ

The contemporaneous documents indicated they preferred another design.

In that connection your Honor will hear, if not called by the plaintiff, from Mr. Frank Bracha of Bally, the patentee of this second Bally patent.

Your Honor will also hear from another individual involved with microprocessors and pinball named Bill Guyton. Mr. Guyton undertook to, in 1975, contemporaneously and independently from the filing of the invention here, Mr. Guyton undertook to take the Intel manual, look at the drawing in the Intel manual, and design a pinball came by, in essence, expanding on that very drawing that occurred in the Intel manual.

12-1

Your Honor will hear from Mr. Allen Edwall, an engineer who was with Gottlieb. Mr. Edwall will testify about the Gottlieb system. Mr. Edwall will testify about how it was developed, and Mr. Edwall will refute for the Court the accusations of copying that will be leveled at Gottlieb.

The evidence will establish that the pinball companies, the three pinball companies in Chicago, have for time immemorial acquired or obtained for inspection every single pinball game of the other two competitors and looked at them. That has been an industry practice since the '40's. That is not a basis for asserting copying.

Finally the evidence will be adduced from individuals at Rockwell, perhaps if not in plaintiffs' case, then in defendants' case, about the development procedure of the Gottlieb game, the development occurrences. The Court will find that in each instance, it took time, some time, to iron out the glitches in microprocessor-controlled pinball games.

Mr. Nutting and Mr. Frederiksen, the evidence will show, supposedly began in 1974, but a commercial game didn't appear until late 1976. Others took some time, and the taking of time is merely a reflection of the oncoming rush of microprocessor technology, the decrease in microprocessor prices.

It is not an indication of unobviousness because

when the evidence to the Court focuses on the claims, the Court will understand that the claimed invention, that aspect of the invention which is isolated on in the claims, is indeed old, had been accomplished by others prior to Mr. Nutting and Mr. Frederiksen and, under 35 U.S.C. Section 103, is obvious.

Your Honor will hear from an expert witness, Mr. Andre Vacroux from the Illinois Institute of Technology, an acknowledged expert in microprocessors and microporcessor design. Mr. Vacroux was in the art at the time, and Mr. Vacroux will elaborate upon various of the prior art references for the Court.

Your Honor may also hear from Mr. Donald Dunner. Mr. Dunner is an expert in patent practice, and his testimony may be necessary depending upon the testimony that is adduced from Professor Kayton.

Finally your Honor will likely hear from another Bally employee, if not in Bally's case, in defendants' case, a Mr. William Anderson. Mr. William Anderson had an explanation and went into the reasons for the commercial success of Bally's pinball games. That commercial success, as reflected in the documents of Bally, is a commercial success which is not attributable to the Nutting way, and the Nutting way is the way that is involved in this case.

Your Honor, I am sure that Mr. Goldenberg has some words to say. That would conclude my opening statement.

THE COURT: All right, thank you, Mr. Lynch.
Mr. Goldenberg?

MR. GOLDENBERG: Would you want me to do that now, or --

THE COURT: How long do you think you will be?

MR. GOLDENBERG: I am sorry. I don't think more than ten minutes or so, Judge.

THE COURT: Is there someone else who wishes to make an opening as well?

MR. GOLDENBERG: No, that would be the end of it.

THE COURT: Why don't we get all opening statements out of the way.

MR. GOLDENBERG: All right, Judge.

12-2

OPENING STATEMENT ON BEHALF OF DEFENDANT WILLIAMS ELECTRONICS

MR. GOLDENBERG: As Mr. Lynch told you, I will attempt to avoid repeating all that he has said to you earlier this morning.

THE COURT: Excuse me just a moment.

Are Gottlieb and Rockwell the same --

MR. LYNCH: Your Honor, Rockwell made the microprocessor system, and Gottlieb made the pinball machine. There is a claim here that Rockwell induced infringement or is guilty of contributory infringement.

We have an infringement defense. I didn't go i nto that because of the time.

THE COURT: But you are representing, Mr. Lynch, both Rockwell and Gottlieb?

MR. LYNCH: Yes. I think that is fair to say, yes, your Honor.

THE COURT: All right, thank you.

Thank you, Mr. Goldenberg.

MR. GOLDENBERG: Your Honor, I think as the evidence proceeds in this case, several things will become quite clear and beyond dispute. One is that the patentees, Nutting and Frederiksen, did not invent pinball. They did not invent the microprocessor. They did not even invent or were the first to conceive of the idea of uniting these two devices.

What that evidence will show is that what was involved here was in substantial part a question of economics. As Mr. Lynch has told you, over the decades that the pinball industry has been in existence, it has learned to do some things very well. One of the things it has learned to do was to manufacture in a very economic fashion a relatively complicated device, a device with many, many switches, many, many electrical parts, and before this case is over, you will see the interior of this device here, very complicated, many switches, many relays, many other electric parts, but the industry knew how to make that. They knew how to make it well.They knew how to make those parts well.

Until and unless the solid state devices, the microprocessor, became economical in comparison to that, there was no way the industry was going to change.

They were aware that going solid state, going microprocessor, would gain certain advantages. The product would become lighter. Indeed, they might have the capability of additional versatility in the game, but nevertheless, until the economics were right, the industry did not do it.

In 1972, in 1973, the evidence will show, the economics became right, and that is when the industry moved, and it moved slowly at first; but even there, economics continued to play a role, and in this sense. There were literally hundreds and thousands of electromechanical pinball games out

on the market, all built by these three Chicago companies that have been named to you. Until those responsible in the industry gained some feeling that it would be possible to put out or take advantage of this new technology and have the same performance, have the same reliability, have the same people capable of servicing them, they hesitated.

There came a time when they didn't hesitate, and so I do say to you that the evidence in this case and an issue that we will be talking about is the economics and the technology with which we are dealing.

Now that, therefore, leads me to the point that the evidence will further show that those were the issues. Technological barriers were not the issues. That here was this device, the microprocessor, that microcomputer, created for precisely the purpose for which Mr. Nutting and Mr. Frederiksen proposed to use it; that is, as Mr. Lynch has said, to detect switch closures and perform an intelligent operation depending on which switch was closed.

That is why that device was created. The evidence will show, indeed, that it was created originally for the calculator, and then its other uses were appreciated and it has spread throughout industry and in proper time to the pinball industry.

All that you have here is an application, therefore, of a known technology to a known device wherein

that known device, the pinball game, does essentially that which it did before. It picked up some additional capabilities because microprocessors have capabilities that electromechanical controls cannot have or do not have without the considerable additional expense, but that is no tribute to this patent because this patent doesn't deal with those things at all.

The plaintiff has told you and will be telling you many times before this case is over about the proceedings in the Patent Office, and you will be told of this long, drawn-out five-year battle in the Patent Office, how careful those proceedings were, how thorough they were.

T13

When you hear all the evidence on that matter, I do not think you will have any doubt concluding that that is not true, that what the patent examiner did here was essentially to assume that the American engineering community is populated by profound idiots. That is not the case because the evidence will establish the point that engineers of reasonable and competent skill could have done this when the economics became right to do it.

Another matter of which you have heard this morning and will hear more is copying by the defendants. The evidence that you will hear, and this will come from Mr. Michael Stroll, president of Williams Electronics; it will come from engineers associated with Williams Electronics that that simply was not true. There came a time when Williams Electronics' management felt it had to make a move and go from electro-mechanical to solid state pinball control. It hired a person well qualified to undertake that task for them, Mr. Michael Stroll.

Mr. Michael Stroll made a decision after considering the matter carefully that Williams had to develop its own in-house engineering and computer programming capability. He then went out and recruited a team of people with those backgrounds well qualified to undertake the assignment he wanted to give them. They had one minor thing they had to deal with, and that was to become familiar with pinball machines.

That was accomplished in months, and, indeed, in months Williams was able to offer for the market its first commercial product, the game, Hot Tip, that you see here. That game had originally been on the market, sold in its electro-mechanical version. It was then designed for --I am sorry. The microcomputer was then designed to replace that electro-mechanical control, and the same game was sold in the solid state version, which leads me to another point.

13-2

This is perhaps repetitious of what Mr. Lynch has said, but I think it bears some slight repeating, and I do wish to elaborate on it: This business of commercial success.

As Mr. Lynch has told you, the evidence will show that the games sold by Bally, the games sold by Williams, the games sold by Gottlieb, do not use the Nutting device at all. They do not come anywhere near it. They are quite different circuits. Bally does not use it.

In any case, on this commercial success point, and I diverted there -- on this commercial success point, the evidence will establish to you that what sells a pinball game is its playing features, is how dynamic is the game, what is the player, how much is the player attracted to it. That is what has sold pinball games from the moment they arrived on the American entertainment scene. That has not changed. The sales figures that will be presented to you will graphically demonstrate that because they will show a whole list of game names and the numbers sold, and this is going to be true whether they are coming from Williams or whether they are coming from Gottlieb or whether they are coming from Bally.

What you will see from the inspection of that list is one game will sell 2,000. Another game will sell 25,000. They both have solid state controls. They both have microprocessor controls, but one game is a better game than

the other game. Its player appeal is far more effective in selling the game than what is enclosed within the box that you see over there. That is what sells games.

The matter of noise. A pinball arcade, I think the evidence will perhaps agree and there will be no dispute between the parties, is an electrically noisy environment. A pinball game is an electrically noisy device. Steps have to be taken to deal with that. But, once again, the evidence will show electrical noise is a phenomenon that has been with the electronics engineer since the beginning. He knows about it. He knows he has to deal with it.

The evidence will further show that in the pattern of developing any device, what the engineer does is to design his circuit, to develop the electronics that he wants to develop, and then as a second-order thing, as a thing which must be dealt with before he puts his product on the market, he deals with the noise and other second-order problems, and he knows how to do that.

No invention was required to solve that problem to the extent that it was a problem.

13-3

13-3b1

problem

In any case, the evidence will show that the technique utilized by Nutting and Frederiksen to solve or to attempt to solve the noise problem as they saw it is not used by anybody else. It is not used by Bally. It is not used by Williams. It is not used by Gottlieb. So nothing was derived there.

My final point is this copying matter. I spoke earlier of Mr. Stroll recruiting a staff of competent engineers and computer programmers, and that is just what he did. The evidence will show that those people came from an industry that was already using microprocessors. They knew how to use them. They did not copy Bally at all. There was no need to copy Bally.

In that connection, if they copied anything, and the evidence will show you this beyond a doubt, that what they copied was the literature of the company that built the microprocessor they were using, the Motorola Company.

You will see that the circuit arrangement, what engineers refer to as system architecture, used by Williams in its product is identical to a circuit architecture proposed by Motorola in a printed publication more than one year before the application for this patent was filed. I think when you hear that evidence, you will have no doubt on that point.

So with that I conclude, your Honor, and we can go ahead.

THE COURT: All right. Thank you, Mr. Goldenberg. We will recess then until 2:00 o'clock.

(Recess was taken until 2:00 p.m. of the same day, Tuesday, January 3, 1984.)

BALLY MANUFACTURING CORPORATION, a Delaware corporation,

Plaintiff/Counterdefendant,

vs.

D. GOTTLIEB & CO., a corporation, WILLIAMS ELECTRONICS, INC., a corporation, and ROCKWELL INTERNATIONAL CORPORATION,

Defendants/Counterplaintiffs.

) Docket No. 78 C2
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) Chicago, Illinois
) January 3, 1984
) 2:05 p.m.
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VOLUME I-B
TRANSCRIPT OF PROCEEDINGS
BEFORE THE HONORABLE JOHN F. GRADY

TRANSCRIPT ORDERED BY: MR. JEROLD B. SCHNAYER
MR. MELVIN M. GOLDENBERG

APPEARANCES:

For the Plaintiff/Counterdefendant:

MR. KATZ
MR. SCHNAYER
MR. BURNS
MR. TONE
MS. SIGEL

For the Defendants/Counterplaintiffs:

MR. LYNCH
MR. HARDING
MR. GOLDENBERG
MR. ELLIOTT
MR. RIFKIN
MR. HANDLER
MR. HOWARD ARVEY

Court Reporter:

LAURA M. BRENNAN
219 South Dearborn Street, Room 1918
Chicago, Illinois 60604

MR. TONE: Good afternoon, your Honor.

THE COURT: Mr. Tone.

MR. TONE: The plaintiff calls as its first witness Jeffrey E. Frederiksen.

THE COURT: Excuse me just a moment. There may be another matter. If you'll hold on just a minute, we have a criminal matter.

(The Court gave its attention to other matters on the call, after which the following further proceedings were had herein:)

THE CLERK: 78 C 2246, Bally Manufacturing vs. Gottlieb, case on trial.

THE COURT: Mr. Tone.

MR. LYNCH: Your Honor, may it please the Court, may I note the appearance of Mr. Howard Arvey on behalf of Gottlieb.

THE COURT: Mr. Arvey. Good afternoon.

Now, at this point all persons other than those we've allowed to be here should be excluded from the courtroom.

And your first witness, Mr. Tone?

MR. TONE: Is Jeffrey E. Frederiksen, your Honor.

JEFFREY E. FREDERIKSEN, PLAINTIFF'S WITNESS, SWORN.

DIRECT EXAMINATION

BY MR. TONE:

Q. Will you state your full name and spell your last name, please.
A. My name is Jeffrey E. Frederiksen, F-r-e-d-e-r-i-k-s-e-n.
Q. By whom are you employed?
A. Dave Nutting Associates. It's a wholly owned subsidiary of Bally.
Q. Is that Bally Manufacturing, the plaintiff in this case?
A. Yes.
Q. Will you please describe generally the nature of the business of David Nutting Associates.
A. Dave Nutting Associates is primarily involved in the creation of new coin-operated games.
Q. What position do you hold with that company?
A. Director of engineering.
Q. And what are your responsibiltiies in that capacity?
A. I primarily direct the electronic designs of new coin-operated games.
Q. Please describe briefly, Mr. Frederiksen, your post-high school education.
A. I went to St. Thomas College in St. Paul for three years, from 1962 through '65, and then --
Q. Majoring in what subjects?
A. Math/Physics major.
Q. And then?
A. Then I went to the University of Wisconsin, Milwaukee,

for one year, and then I joined the air force.

Q. What kind of work did you take at the University of Wisconsin in Milwaukee?

A. Changed to electrical engineering at that time, computer science major.

Q. And at the end of that year did you or did you not receive a degree?

A. No, I did not.

T2

Q. What did you do at that time?

A. From then I joined the Air Force.

Q. Tell us about your service in the Air Force insofar as it relates to your education.

A. I joined the Air Force in electronics as a communications technician and had almost the full four years that I was in the Air Force as training and experience.

During my time in the Air Force, besides dealing in the area of communications and multiplexing, which is communications relay centers that I worked in, which were like Bell Telephone overseas for the military, I was exposed to the multiplexing there and after that went into a maintenance management position, where I got involved with computers on the Air Force base.

Q. In what way did you get involved with computers?

A. I started as a keypunch operator and then took the cards down to the computer center at the Air Force base, where they printed off the listings of the cards that I had punched up.

They did no checking, so I asked them if it would be possible for us to have the computer check these cards for us instead of us having to check them manually for errors. They were unable to do it, or they had no programs to do that and they had no authority to do that, so they gave me the manuals and said that I could read up on it and attempt programming it myself to do that task.

Q. What did you do then?

A. I did take the manuals and worked after hours on their computer system to develop programs, even though they wouldn't give me access to their assemblers, these machines that put the programs together from the English language. I had to do it in machine code directly on the computer and finally did succeed in getting the computer to check the cards, the maintenance management cards, for us, and we had dropped our error rate down from 10 percent down to zero.

Q. You were in the Air Force for four years?

A. Yes.

Q. What did you do when you were discharged or released?

A. After leaving the Air Force, I went to work at Radio Communications and also went to school part time in the evenings, again at the University of Wisconsin, Milwaukee.

Q. What kinds of courses did you take there?

A. Electrical engineering again, computer science major.

Q. Will you then focusing on your employment history tell us what you did after you left the Air Force. You have told us the firm you went with then and take it from there.

A. I went to work for Radio Communications, taking advantage of my communications training at that time as a technician, repairing two-way radios. These are police and taxicab radios.

Then I went to Ken-Com, Inc., which is another communications firm, handling General Electric radios this

time instead of Motorola.

I worked there for a couple of years and moved into sales at that location.

Then from there I went to Milwaukee Coin Industry full time. Before I went there full time, while I was still at Ken-Com, I had worked for Milwaukee Coin Industry as a consultant in the summertime full time.

Q. When did you go with Milwaukee Coin Industry full time?

A. It was in the October time frame of 1973.

Q. On or about July 1st, 1974, did your employment change?

A. Yes, Milwaukee Coin Industry was cranking down its business and Dave Nutting had split off and started Dave Nutting Associates. I went to work with Dave Nutting, and I have been with Dave Nutting Associates ever since.

Q. Calling attention to the year 1976, did Dave Nutting move its business in that year?

A. Yes, around that time frame we moved from the Milwaukee area to the Chicago area.

Q. Was that to Arlington Heights, Illinois?

A. Yes.

Q. What, if anything, happened with respect to Dave Nutting Associates in 1977?

A. Dave Nutting Associates was acquired by Bally.

Q. Have you been in your present capacity with Dave Nutting Associates since the acquisition?

A. Yes.

MR. TONE: May I approach the witness, your Honor?

THE COURT: Yes. Let me just establish as a convention that counsel may approach the witnesses throughout the trial without asking permission.

MR. TONE: Very well.

BY MR. TONE:

Q. I hand you, Mr. Frederiksen, a copy of what has been marked Plaintiff's Exhibit 3.

Will you tell us what that is?

A. This is the re-issued patent that I filed back in May 1975.

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MR. TONE: We offer the patent, your Honor.

THE COURT: All right, it is received.

(Plaintiff's Exhibit No. 3 for identification was received in evidence.)

MR. TONE: Does your Honor care to see it now, or shall I hold onto it?

THE COURT: If you are going to start discussing it now.

MR. TONE: I think we will not be discussing it.

THE COURT: All right. Why don't you hold it until we do.

MR. TONE: All right.

BY MR. TONE:

Q. Will you please describe in general terms, Mr. Frederiksen, the nature of your and Mr. Nutting's invention as reflected in this patent?

A. The invention is a microprocessor-controlled pinball machine with multiplex matrix of switches and display devices.

Q. When did you and Mr. Nutting begin discussing the possibility of designing an electronic pinball machine?

A. Very early in my employment, in the first weeks of my employment, at MCI.

Q. I am not sure you told us exactly when your employment began there, but will you tell us now?

A. Towards the end of October in 1973.

Q. Did you have a single conversation with Mr. Nutting on this subject, or were there a series of conversations?

THE COURT: May I interrupt for just a second and ask -- I will either have it read back, or you can give it to me again if you conveniently can, and that is, your description of the invention. I was writing it down, and I did not get it all down before you went on to the next question.

THE WITNESS: It is a microprocessor-controlled pinball machine.

THE COURT: With a?

THE WITNESS: With a multiplexed matrix --

BY MR. TONE:

Q. Did you --

THE WITNESS: -- of switches and displays. The displays could be lamps or digits.

THE COURT: Does that complete it?

THE WITNESS: Yes.

THE COURT: All right, thank you.

BY MR. TONE:

Q. We were talking about a discussion you had with Mr. Nutting which you said took place over several conversations.

Can you isolate and identify any particular

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one of those?

A. No.

Q. Taking them as a group, will you tell us in substance what you said and what Mr. Nutting said in those conversations?

A. This was my period of first real exposure to the games industry, and Dave was giving me some background of the games industry and told me that the pinball business was the primary staple in the games industry.

MCI had them primarily involved in doing novelty games. They had quite a bit of success with an IQ computer game previously and had presently -- they were working on an airball game,but, basically, they were doing novelty pieces.

They had a Red Baron flying game, and these were not considered staple items because they were one-shot deals. They would go into production, run a few hundred or a few thousand pieces, and they would be out of production again, and then they would be looking for another idea.

He said if he could get into the pinball business that that was the majority of the marketplace. More specifically, he later said that he wanted to get into the two-player pinball area because there were not that many four-player pinball machines, and that would be effective for the majority of that marketplace.

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We have talked about this over a period of time, three or four weeks, or two or three weeks in that period.

He then asked me to give some thought to actually trying to build a pinball machine.

4-1

Q. Did he say anything about where -- whether he -- where he had in mind manufacturing a pinball machine, if one was designed?

A. Yes. This was a great concern of Dave's. His facility was primarily electronic.

They had done some electromechanical designs, but they had to purchase all their relays and other electromechanical devices, and they were very expensive. He said that it was very difficult to build an electromechanical game such as a pinball machine, because it required tremendous vertical integration.

By that I mean that you have to be able to build your own relays to be cost-competitive; not only relays, but they have just a host of parts inside of one of those machines.

They have the large drums and the steppers and they have motor mechanisms inside for logic functions and sequencing functions. They were -- the machines were incredibly involved inside.

And if he had to purchase all those parts, he could not cost-effectively participate in the pinball business.

And so he thought that he should -- rather, we should do it electronically. He asked me to think about building an electronic pinball machine by using one of the conventional logic families or a microprocessor.

Q Why -- did he say why an electronic, electronically driven pinball machine would be cheaper to build than an electromechanical game of the conventional type?

MR. GOLDENBERG: Objection, your Honor. It's an invitation to hearsay, and certainly a leading question.

MR. TONE: As to the hearsay, your Honor --

THE COURT: Well, you don't have to answer the hearsay.

The leading -- I suppose it is a little bit leading. But I'm going to overrule that, too. Go ahead.

BY MR. TONE:

Q You may proceed to answer.

Do you have the question in mind, Mr. Frederiksen?

A Yes.

Q All right.

THE COURT: The answer to the hearsay, of course, is, I'm not accepting this for the truth of the statement, but for the fact that it was stated.

I mean, this is the conversation between the inventors that allegedly gave rise to the invention. It's being offered for the fact that it took place.

MR. GOLDENBERG: Understand, Judge.

MR. TONE: Exactly.

BY THE WITNESS:

A. Dave was saying that the -- his primary mode of manufacturing was electronics; they used printed circuitboards and the different logic families that were available in those days for substituting relay-type logic.

They had done some designs like this already in some of the previous games. And instead of having to hand-wire relays, which were very expensive -- about, you know, about two and a half to five dollars apiece -- he could use the electronic logic equivalents, which were in the 25 to 50-cent range.

Also, these electronic parts could be put on these printed circuitboards instead of hand wired, which means that there was much less labor content in the assembly of the logic.

And that was the primary reason.

BY MR. TONE:

Q. All right. Did Mr. Nutting give you any instructions as a result of these discussions?

A. Yes. He asked me to think about designing an electronic pinball machine.

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Q And what if anything did you do in response to these instructions?
A. I started a series of conversations with Dave, in an attempt to define what a pinball was.
Q When you refer to Dave, you mean Mr. Nutting?
A. Yes.
THE COURT: Do you have the approximate time when this conversation took place?
MR. TONE: Thank you, your Honor.
BY MR. TONE:
Q When did these conversations occur, the ones that you were about to tell us about?
A. The times that I had the conversations with Dave about defining the pinball machines were after the MOA, that's the Music Operators of America show in Chicago here, and that was--
Q And when did the MOA take place?
A. That was the second week of November.
Q And the year?
A. 1973.
Q All right.
A. We started these conversations about what was a pinball machine.
He explained a little bit to me about them at the show, and I had seen them there, many of them. But I did not really understand how they worked inside, or what

really all the requirements were.

I had played a pinball machine; most of us have. But I had no idea what was required to make them work.

And so I started asking him a series of questions in an attempt to try to logically define what a pinball machine really was, as far as what devices did you need and what type of logic functions did it have to perform.

Q And did you arrive at a definition or definitions of a pinball game with Mr. Nutting in those conversations?

A. Yes. Yes, we did.

Q And state what was said on that subject.

A. I'd asked him several questions about what the elements were and he said that they were primarily consisting of lamps and switches and solenoids and a digital display of some sort, the scoring drums.

Then I asked him further how many lamps would be necessary. And we finally came to the conclusion that he needed about 40 or 50 lamps.

And I picked a binary number that was close to that -- this was a computer number -- the number 64, and asked him if that would be sufficient. And he said, yes, that should be plenty.

By the same token I asked him about switches, and we came to the conclusion there also, 64.

And then as far as the number of digits,

remembering that our objective was to do a two-player pinball machine, he said that for a two-player, 16 digits should be sufficient.

And so also we needed some solenoids for things like the pot bumpers and the side kickers and the chimes that were in the machine, which we had intended to keep in the beginning.

And that added up to somewhere around 10 to 15 solenoids that he would need. So we said that 16 should be an adequate number for solenoids.

THE COURT: I'm not going to understand your answer, but what is a solenoid? If you tell me about ten times, I'll probably get it on the tenth time.

THE WITNESS: That's the electromechanical device that actually makes the flippers move. It's a plunger-type of thing, almost looks like a shock absorber.

T5

BY MR. TONE:

Q Can you explain very simplistically for me, as well as his Honor, Mr. Frederiksen, how a solenoid works, that is, physically how it works?

THE COURT: You mean one of those things on the pinball machine that flips?

THE WITNESS: Yes, there is a coil underneath, a coil of wire, and it is an electromagnet, and then it pulls in a plunger of steel and that is what makes the flipper move.

THE COURT: I see.

BY MR. TONE:

Q When a current is sent through the coil, what happens, as a matter of physics?

A. It becomes magnetic, of course, and it magnetically pulls in that steel plunger. That steel plunger is connected through linkage to the top of the playfield, just to a shaft, and then when the plunger pulls in, the flipper moves with it.

Q The coil and the plunger magnet together are what is known as what?

A. That is the solenoid.

THE COURT: This is an electrical part that is not peculiar to pinballs but is used in other devices as well; is that it?

THE WITNESS: That is correct.

THE COURT: I see. Thank you.

BY MR. TONE:

Q With the Court's permission, Mr. Frederiksen, will you step down to these two pinball games, both labeled "Flicker," to the Court's right and tell us what they are?

May the witness come down and demonstrate?

THE COURT: Yes.

BY MR. TONE:

Q One of these is the original electromechanical game, is that right, Mr. Frederiksen?

A Yes.

Q Which one is that?

A This one here (indicating), 33 --

Q The one that is Plaintiff's Exhibit 332?

A Yes.

Q The other one is what?

A This is an electronic version that we converted from the original electromechanical model.

Q That is labeled Plaintiff's Exhibit 333.

A It might be easier if I take the glass off and play with the parts directly.

Q Proceed to do that.

(Brief interruption.)

THE WITNESS: We commonly take the glass off to play with the pinball machines to get a feeling for how they work.

This one is not started up.

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The ball will come up through the top here, through the plunger, and it can get caught in this hole in the top.

For an example, as the first example of what a solenoid can do, it gets kicked out by again one of these plunger mechanisms on the bottom.

You can see all these different plungers and things. Here is one here. You can see the plunger here.

This steel plunger gets pulled inside of this coil of wire when you apply an electric current to the coil by hitting the button, and that plunger action is what causes the thing to rotate to actually flip the flipper.

Those types of solenoids are very common in the games.

BY MR. TONE:

Q. While you have it up there, is there a thing called the pop bumber?

A. Yes, there is a thumper bumper. It is labeled as such, a thumper bumper assembly, which is another coil wire on the back side, and it also has another plunger to it, which when it is activated on the top side here causes the thumper to pull down and kick the ball out.

We can try some.

Something seems to be making some noise here. We must have bumped something.

Q. Proceed to point out the elements of the game.
A. Some of the things that we have on here are things like switches, rollover switches, for example. These little star devices are rollover switches. When the ball goes over the top of these, it causes an activation through a pair of leaf springs on the bottom. When they touch, they make an electrical contact that is an input. This is a target switch -- noisy thing -- and when you push the target switch back, it closes a pair of leaf springs again, leaf contacts, and that also gives you an electrical contact.
This is a rollover switch, and when you roll over the top of this, it closes again a leaf switch on the bottom and it gives you another electrical contact. So the primary sensing device on the pinball machine are these leaf contacts.

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THE COURT: May I see what one of those looks like?

THE WITNESS: These are the simple leaf contacts here. Here is one where there is just one contact. When the rollover pushes down here, it makes these two metal pieces touch.

This is basically the heart of all the different contacts on the machine. Some of them get very complicated, and the logical functions, as you can see -- these are some relays which are electromechanical devices that close contacts. So they are like a solenoid except that they have switches associated with them. When they close, they can stay closed and memorize things, so that you can get an idea of how you are doing in the game, or memorize some other features of the game like bonuses and whatnot.

There's a lot of relays and switches and whatnot on the bottom of the cabinet.

Here's a logic assembly. It is a sequence search of some sort. Those get to be very complicated and very expensive devices.

THE COURT: I take it that the term, electromechanical, means that you have got a mechanical device or a series of mechanical devices that are activated by electricity?

THE WITNESS: That is correct.

This is purely a very evolved version of the electromechanical industry. There's a lot of electromechanical application here.

BY MR. TONE:

Q. You have described the various switches.

What happens when the switches are opened and closed with reference to the other parts of the machine, the display system?

A. Well, through the logic functions underneath, scoring may be required, and that will go to the drum assemblies in the back, which are electromechanical as well, and they have solenoids and will kick up the scores of the different columns. That is basically how scoring is accomplished.

The side kickers are also switches. You can see a pair of leaf switches sticking out of the side here, just right here. When the switches touch, the solenoid kicks the ball out.

It is a combination of a switch and another solenoid.

The target switch here, this spinner switch, is a special kind of a switch. When the ball hits it, it can make a series of activations. So as that spins, it rolls up. It lifts on a contact underneath, and it can cause more than a single activation.

Some of the balls on the playfield are

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also -- there's more than one ball here. For example, you have these captive balls, and when the ball hits that, they go up and hit the switches on the side.

So it is a peculiar feature of this game, the captive balls on the playfield.

So this is basically the switches and the solenoids and lamps.

5-2

The lamps that I am referring to -- there's two kinds of lamps on here. The lamps that are actually under control the game. For example, we have to be able to turn these lights on and off, the ones underneath the scores, the shoot again lights, the extra ball light, the special features lights like getting into A, B, C, D targets hit.

Other lights like the lights that are buried behind the plastic overlays here are general illumination lamps. They are just to light the game up. They really serve no logical function. Those are wired up permanently as on through a relay just to turn them on when the game is on. They just stay on throughout the entire game.

So those are the two types of lamps on here.

So we have basically the lamps, and we have the switches and the solenoids and the digital display mechanisms. With these you can construct any pinball machine.

Q. Would you remove the cover from the electronic game just to show the Court what that looks like inside?

A. Well, you might be interested in seeing the back of this one since it is also quite complicated.

Q. This one, referring to 332?

A. Yes.

Q. Proceed with that then while someone else takes the

cover off the electronic game.

A. The majority of the stuff that is in the back of this cabinet is electromechanical logic. There's really no switches or anything to hit back here. It is the solenoids with the switches to do the logic functions primarily. That is all that is back here.

Also, we have these scoring drums, and they can be hit to sequence the scores up and down. That is basically how the machine scores.

This is another type of drum assembly that is used for logic, not used for display, and, again, it has a solenoid on there, and it has a lot of contacts on this thing.

The most important point to note about this is there is a tremendous amount of relays and wires. It is a real rat's nest.

The trick is when I looked at this is that I had to figure out some way not to have to do all that.

Q. All right. Let's turn to 333, which is the electronic game.

A. Now, the electronic game -- this is the version that we -- we basically took an electromechanical machine like this, and we gutted the insides out, just simply took out all the works out of the inside and piled them on the table.

We still had to retain the lamps and the

simple switch parts to at least know that we have a ball sense and the solenoids that were required to do that actual ball motion or the flipper motion.

In the back box, none of the mechanism that was in the other machine exists anymore. It is not all electronic.

We still have the chime assemblies with their solenoids as solenoids that are required, and there is a device in here called a knocker. That just tells you that you have got a credit. So every time you drop a quarter in, the thing sounds off and tells you that you have another game.

So you can see that there's like three, four, five, six, seven, eight, nine, ten -- there's about ten solenoids in this machine. So the solenoids are a pretty important feature.

-3

feature

The target switches can also be seen here as sticking up through the playfield, and these are also a type of switch, but they are right on the surface.

As the ball hits the target, the switches close, and it is very similar to this rollover switch.

Q. Where is the power supply, Mr. Frederiksen?

A. The power supply is these transformers in the bottom. They take the AC power and convert it to the low voltage, very much like a train voltage, so it is something you really cannot get too hurt on the side of the machines.

Q. All right.

A. This is a coin counter. These appear in both games. This coin counter keeps track of how many conis are dropped in the machine.

But the important thing to notice in this one is that the bottom box is quite vacant.

Q. Would you open up the back of this machine and tell us about that?

A. In the back of this machine all the electromechanical logic is gone, and we replaced it with our electronic package consisting of two parts here. We have the Bally Brain that we called it. It had a nice aluminum cover on it for demonstration purposes that plugs into this board here called a mother board. The mother board contains all the power transistors necessary to replace the relays that you saw. Relays

can handle a lot of power. The fine electronics cannot.

So these power devices here allow us to turn o the large solenoids and the lamp drives that are necessary to drive all the current or the power necessary for this machine.

That is the total logic package now.

As a matter of fact, this mother board is actually not logic at all. It is just power devices. The actual logic is in the little electronic card over here, and that contains the microprocessor.

THE COURT: Where is the microprocessor itself?

THE WITNESS: The microprocessor is one of the chips on this board.

Maybe I should unplug the board and show you the parts on the other side.

BY MR. TONE:

Q All right. If you can do that without harming the machine, do it, because we want the machine later on to be working.

Go ahead.

THE COURT: If that is too complicated, we can wait until some later time.

MR. TONE: Let's do it because we can put it back together, your Honor. We can come in early and do that if necessary.

(Brief interruption.)

THE WITNESS: This is actually the electronic computer package, and it consists of a 4004 microprocessor chip. They were very tiny then; they didn't have the bigger packages.

This is the program memory. And these parts actually contain the programs that are written and then programmed into these parts and then plugged into the machine.

These parts are actually glassed windows, so they're erasable; you can actually reprogram them several times.

The rest of the electronics on there is some interfaced circuitry to do the decoding necessary to drive the power devices.

MR. TONE: For the written record, the witness has pulled off a panel from the right center of the machine, and after he pulled it off there was a reading "Bally brain" underneath it.

I guess that sufficiently identifies it.

Can you tell us where on the panel the microprocessor is?

THE WITNESS: It's one of the 16 pin chips labeled with a large letter "E" followed by the nomenclature "C4004".

MR. TONE: And what are these? I'm pointing to

now a long -- the larger rectangular --

THE WITNESS: The parts labeled with the nomenclature "C1702A" are the EPROMs, or electrically programmable read only memories, or the program for the machine.

There's also some other Intel parts on here. There's a 4008 and a 4009. These two parts are the standard memory interface.

MR. TONE: Can you describe in words in some way so they can be identified?

THE WITNESS: They're the larger chips on the board. They're 24 pin plastic parts. They're grey colored.

They allow us to use these parts for a prototype. In a production unit you wouldn't use these EPROMs, they're too expensive.

THE COURT: You say the larger chips. Is there more than one chip on that board?

THE WITNESS: Yes. A chip refers to -- I'm sorry, I assumed that -- refers to the electronics --

THE COURT: You can't assume anything.

THE WITNESS: When we talk about a chip, it's that little piece of electronics in the center of a package.

This electronic device is an integrated circuit. But the actual integrated circuit is the silicone printed part in the middle of the package. And then they have to bond wires out to get them to the actual feed on

the package to connect them into the circuitry, and that's called a chip, that little thing inside.

THE COURT: The little thing.

Now, where is the chip on what you have identified as the microprocessor?

THE WITNESS: Well, we loosely refer to the entire part itself as the chip. Actually, underneath the lid here, there's a chip inside of all these parts.

THE COURT: And those are all silicone chips?

THE WITNESS: Those are silicone chips.

THE COURT: What is it that connects the microprocessor to these other devices on this board, or chips on the board?

THE WITNESS: First of all, you can see that the chip itself is actually welded to the large legs. Can you see the little wires in there?

THE COURT: Yes.

THE WITNESS: Now, the wires are tied out to these legs; then we plug it into the socket which now brings the legs out the bottom, and then we can twist wires on there to wire them all around.

THE COURT: So it's wired on the underside.

THE WITNESS: On the underside.

So we have the ability to design, with these components, any way we wish.

MR. LYNCH: Can you leave that off so that it can be photographed -- I don't want you to put it on and off -- I would like to be able to have my expert examine that board.

MR. TONE: We'll take it off again for you. Let's put it back on for now.

MR. LYNCH: All right.

MR. TONE: Just let us know.

8-1

BY MR. TONE:

Q Will you resume the stand then, Mr. Frederiksen, unless there is something else you can think of that you can show us on those machines.

Can you briefly describe the chips themselves. We spoke of chips when we were standing at the machine. What is on each chip?

A. A chip is like a little printed circuitboard. It is a photograph of electronic components. It is a piece of silicon, and it is very tiny. They are typically smaller than about two-tenths of an inch on a side, and we can actually now print electronics on those chips.

Q. What do the electronics consist of?

A. Primarily transistors and resistors, many of them into one package.

For example, many years ago we used to hear of a six-transistor radio. In one of those chips you can put several thousands of transistors in them, so there can be some relatively complex electronic logic inside of just one chip.

THE COURT: What are the transistors themselves made of?

THE WITNESS: They are all made out of silicon. The silicon is actually made active through a manufacturing process that the silicon houses do all the time now. That was something that was discovered when transistors were discovered.

THE COURT: The transistor is part of the original chip, is it?

THE WITNESS: The chip is a printing of a large number of transistors on a single part.

The chip itself is actually grown. It is a crystal, a silicon crystal that is grown in very large ingots. In fact, they grow them now as large as six inches in diameter.

THE COURT: Maybe it would help if you just very briefly give us the manufacturing process of a chip.

You start with one of those raw chips that has been grown, and then what do you do?

THE WITNESS: That is actually a large crystal. It could be several inches in diameter, and it could be several feet long.

They slice that into very thin wafers. So you have these circular wafers that are about four inches in diameter, but they are very thin.

BY MR. TONE:

Q About how thick?

A. These wafers are now sensitized, very much like a negative, with chemicals, and they etch into these wafers, which are very pure silicon, and they contaminate them under controlled conditions to make them now not an insulator any more, not a semiconductor, but now conducting.

Then these, if they do it properly, form

transistors. They actually print the transistors on that silicon wafer. They can print a whole --

Q. Do they print a circuit on that wafer or a number of circuits?

A. They can print the transistors on that large wafer, in fact, many copies of a particular circuit. Let's say, for example, one of those chips had 500 transistors on it for one circuit that is in one of those plastic packages. A wafer that is four inches in diameter, you can put several thousands of those little chips on there because, as you saw, they are very tiny.

THE COURT: When you say "print on the wafer," what is it in that printing process that corresponds, say, to the ink in a normal printing process?

What I am trying to find out is what is the transistor material itself or what is it that is done to introduce some new element that is the transistor?

THE WITNESS: You start out with a semi-conductor, which is pure silicon. This is almost like glass. It is not very conductive. Then they add dopants, which contaminate the silicon and make it now conduct a little bit.

Now, the way they do that is they first of all coat it with a chemical, expose it with a source, very much like exposing a photograph or printing a photograph, and then they wash off certain areas and it leaves a pattern on the

4 silicon piece of material.

Then they put that in an oven at very high temperatures, and they introduce the dopant as a gas. Now, that absorbs into the surface, where the picture has been washed away.

Then through a series of processes like this, they generate layers on the silicon, and it actually builds up the circuit. So they may do this eight or ten or twelve times. Then you end up with finally a finished wafer.

They then scribe the wafer because there are many chips on one wafer, and they break them up with something like a rolling pin, and then they assemble each of the individual parts into a plastic housing.

8-2

housing BY MR. TONE:

Q The resulting chip you told us is less than a quarter of an inch square typically?

A. Yes, they are very tiny.

Q Approximately how thick would it be?

I recognize there are many kinds, but take a typical one of the kind you used in this device.

A. They are very thin, typically the thickness of a few sheets of paper, two or three sheets of paper. They are very thin.

Q Returning now to your work on this particular development, what did you think of as a way to implement the electrical definition that you and Mr. Nutting arrived at of a pinball machine?

A. I had never dealt with power before, and a pinball machine is by far the biggest power hog in the games industry. They have all the solenoids, which can take amps of current, and a tremendous number of lamps, each one of which can take a quarter to a half an amp of current, just a tremendous amount of power.

So my biggest concern at the time was how to get all this task accomplished for a relatively low cost.

If, for example, we wanted 64 lamps, I would have to put in 64 power transistors to drive those 64 lamps. Realizing I really didn't want to have to pay that much money

for that many drivers, I had thought of putting them in a matrix and, for example, instead of having 64 lamps in a row with 64 transistors and 64 wires connecting them, what happens if I had 16 rows or 16 lamps in 4 rows.

We have the same 64 lamps, but there are only 16 lamps per row and 4 rows. That would only require 20 power transistors, not 64. So I could generate a savings by arranging the lamps in a matrix.

Q What size matrix did you have in mind?

A. In the pinball definition, we said we wanted 64 lamps, and so we actually did arrange them in a matrix of 4 by 16, or 4 rows of 16 lamps.

We also put the switches in the same matrix of 4 by 16 for the 64 switches.

The digits also would be put into one digit per column in this matrix, and then we had 16 digits, one per column.

Now, a digit is really very similar to a lamp. The digital displays we used are those very similar to electronic watches or electronic calculators in as far as they have 7 segments, and that would be pictured as 7 light bulbs.

Those 7 light bulbs were very similar to the 4 light bulbs that would be on a column on the lamp matrix. So actually the digital display could be looked at as a matrix

of 16 lamps in a row and 7 rows. So that would make a 7-segment display.

Q Would you draw a 7-segment display on this tablet of paper here?

It has already been marked Plaintiff's Exhibit 326.

(Brief interruption.)

MR. TONE: Excuse us for a minute, your Honor, while --

MR. LYNCH: I used a pre-marked sheet, your Honor. I apologize. I hadn't realized it had been marked.

MR. TONE: I think it was straightened out by somebody without our knowledge.

BY THE WITNESS:

A. A 7-segment display is nothing more than 7 light bulbs, with the proper light mask to give you a line indication (indicating), and 7 of these segments can indicate any number.

I marked these segments a through g to indicate the 7 segments, and if you were to light, for example, segments a, b, and c, you would have the number 7 here, or if you lit all the segments, you would have the number 8. If you lit all the segments except for segment g, you would have the number zero, and in a similar fashion you can use a 7-segment display, which I viewed as 7 light bulbs, to represent any number.

number

BY MR. TONE:

Q. All right, you may resume the stand.

I will hand you a document marked Plaintiff's Exhibit 7, and we will be talking about this one, your Honor, so if I may, I will hand that up.

What is Plaintiff's Exhibit 7?

A. This is a drawing, duplicate of a drawing that I made on a blackboard in explaining to Dave Nutting the principles of multiplexing in a matrix.

Q. We will come to that conversation in a little while, but does it depict a matrix multiplexing system schematically?

A. Yes, it does.

Q. What is multiplexing?

A. Multiplexing is the sharing of a resource, and this can be done in either time or frequency.

Q. How do you use multiplexing in your invention?

A. The invention uses time division multiplexing. In conjunction with the rows of wires labeled digits and lamps, there is only enough wires to light one digit or seven wires and to light four lamps. To use those wires several times, I can turn on successively one column at a time.

At the bottom it shows drivers. That would activate one driver at a time. Then I could light up that column times the number of lamps, for example.

So there are 16 columns shown here and there

are 4 lamps able to be driven at one time. So the multiplexing would allow me to show 64 lamps on at one time or appear to be on at one time.

Now, this is time division multiplexing. The way that works is that each column is turned on for approximately a uniform period of time in sequence, and this has to happen cyclically and sequentially fast enough so that the human eye can't detect it.

Now, if you do that, even though only four lamps may be turned on at one instant in time, it will appear as though all the lamps that you want on could be on at one time.

That is how we used time division multiplexing.

Q. Will you please step down to the pad again and taking a sheet that has been marked Plaintiff's Exhibit 384, illustrate the concept of matrix multiplexing and explain it to the Court as you draw the schematic illustration.

A. If it is all right, I will use a smaller array so it is not so confusing.

Q. A smaller array being fewer lines and columns than you conceived would be used in your matrix multiplexing system that you described as relating to the invention?

A. Yes.

T9

Q. All right. Go ahead.

A. Let's say that we have only four columns instead of 16 columns.

Now, these columns would be turned on sequentially, one at a time. So this would become 1, 2, 3 and 4.

Then, as we turn the columns on one at a time, we actually tie rows in the matrix as well.

Now, these columns and rows represent wire, just plain wire.

Now, in order to connect something to the matrix -- these wires are not touching at the crosspoints here, now -- and so, in order to connect something --

Q. That is, the blue wires don't touch the red wires, where they cross.

A. Right, the blue wire and the red wires are not touching now.

And so you can connect something like a lightbulb between the two wires at each of the crosspoints.

Now, for example, if I want this lamp on and this lamp on in the first column, all I would have to do is apply a voltage to the first row and the third row. And so if there was a voltage on the first and the third row while column 1 was active, these two lightbulbs would turn on.

And, of course, when you then turn on the second column, you can apply different voltages to these rows; for example, let's say, to turn on row 2, and so this bulb would be turned on.

And then when we turn on column 3, we could, for example, turn on row 4, and that lightbulb would be turned on.

And then when we turned on column 4, finally, here, we might want to turn on rows 1, 2, and 3, lighting up all three of these lamps.

And so the row data changes, depending upon which column that you're on, to get the proper lamps lit up that you want illuminated.

Now, the trick here is to get back to the first lamp before it has a chance to cool off, or before your eye has a chance to see that it ever was left.

And so you have to cycle around fast enough that it becomes an illusion to the eye that it's lit continuously, and not just momentarily.

Actually the lamps are only receiving power in this example only one quarter of the time. But the lamps are actually, appear to be illuminated continuously, as if they're illuminated 100 percent of the time.

We can also very similarly read the switches. We could, for example, have four rows of switches tied to

the same matrix.

Now, by shorting this wire during the time that column 1 is active, this row of switches, row 1 of switches here, would show you that there is an indication, or that switch is closed. Yet, when you go to row 2, whatever switch is there or -- excuse me -- when you go to column 2, whatever switch is closed on column 2, if it is closed or not would be indicated when you activate column 2.

And so by sequentially activating the columns you can look at all the switches in the matrix and determine whether or not they're open or closed.

I hope this is clear.

This is a little lever that closes down here, making this a short circuit.

Q. You might explain to the Court the symbol for an open switch as distinguished from a closed switch.

A. Yes. All these switches are shown as open.

Actually, if they're closed, it would actually be drawn across, showing that the switch is actually connected across.

We usually draw dots to show that the wires are connected to the switch, it shows that there's actually an electrical connection made there.

So that in this array that we showed so far, you could have 16 lamps and 16 switches; but it only requires

four columns and four rows, for example, for the lamps, which would only be eight power devices.

And so, although there's 16 lamps shown here, I only needed eight power devices to drive these wires.

Q. And eight sets -- and eight wires instead of how many wires?

A. Well, for the 16 lamps it required 16 wires going out and one return wire, a total of 17 wires.

So now there's only eight wires instead of 17.

Q. Using the matrix multiplexing system, there are only eight instead of seventeen?

A. That is correct.

Of course, a digit is very similar to a lamp; you have to light up seven segments, so you need, instead of four lightbulbs per digit, you actually need seven lightbulbs.

So we could actually extend our matrix one more time and have the segments also brought out; and then the segment light connections could be made into the matrix very similar to the lamp connections.

The difference here is that they're arranged to look like a number rather than lamps on a playfield. And so each one of these would be one digit.

Maybe I should use a different color and show that.

Like this one would be one digit here, all seven lamps would just represent one digit.

And you could put four digits in this small matrix.

Q. And the seven lamps would be the seven segments of the digits that you drew a minute ago on the prior numbered exhibit.

A. Yes. If I were to draw the lamps physically in here, they would look just like the lamps down here. But schematically it's probably easier to show that they're connected in the array of seven segments.

Q. And the seven lines represent the A, B, C, and so on as you numbered the lamps in your schematic a minute ago.

A. Yes.

Q. If you were using -- if you wanted to have 64 lamps on your matrix multiplex arrangement, how many wires and drivers would you need?

A. Well, we would still keep the same four rows here for the lamps, and we would still keep the same four rows for the switches and the digits.

All we would have to do is extend the columns now. Instead of four columns, we could extend this down to 16 columns.

I will not draw all them in for now, but you can extend this out to 16 columns, and if we did that, we would have 12 more wires out here, or you would have now a total of 64 lamps that you could have on this matrix instead of just the 16. So we can continue this out all the way up.

Q. So in that same way, if you had wired each of the lamps directly, would you have needed more wires and drivers?

A. Well, we would have needed 64 wires to drive the lamps plus the return wire, and you would have needed 64 drivers.

Now, we only need the 16 columned drivers and the four lamp drivers for a total of only 20 drivers instead of 64.

MR. TONE: Would your Honor excuse me for one minute while I confer?

THE COURT: Yes.

(Brief interruption.)

BY MR. TONE:

Q. Referring to the solenoids, are they operated through the matrix in your invention?

A. No, they are not.

Q. Is there a reason for that?

A. Originally we tried to put them into the matrix very much like a lamp row, just a single row of lamps, which would have been 16 solenoids.

The problem is that you cannot deliver enough

energy at that short a time, 1/16th, the time slot. They just sat there and buzzed a little bit. They did not work well. So we eventually chose to direct drive the solenoids.

Q. I think you have covered this, but can you have all of the lamps in a column on?

A. Yes, you can. You can have any one or all of the lamps on in any column.

As a matter of fact, you can have every lamp on in the entire matrix at one time, if you wish.

Q. You also told us, I think, that this was called time division multiplexing?

A. Yes.

Q. Can you tell us how the solenoids that you used would fit into that arrangement you have sketched out schematically?

A. The solenoids would actually be just completely independent, probably -- there is really not any room to draw it on here, but they are just completely independent.

If you would draw another 16 wires at the bottom, that would go directly to the solenoids. It would be directly connected to 16 power devices.

Q. Had you had prior --

Well, you can resume the stand now, Mr. Frederiksen.

(Brief interruption.)

BY MR. TONE:

Q. Had you had prior experience with multiplexing?

A. Yes.

Q. At the time you were thinking of these ideas and how they would work in a pinball environment?

A. Yes, I did.

Q. Where was that?

A. It was in the Air Force.

Q. About when did you come up with this idea of matrix multiplexing?

A. Right after the MOA in November of 1973.

Q. I take it you thought about it for a period of time.

When did you first --

Well, did you or didn't you?

A. I have thought about it for awhile. Again, as I mentioned, I was concerned about the large number of devices and had thought about going to a matrix pretty early to get around the powered device problem.

10-2

Q. Did you have a discussion with anybody about your idea?

A. Yes. I had talked to Dave Nutting and other employees at MCI about that idea.

Q. Do you recall a conversation with Mr. Nutting in early December 1973?

A. Yes, I do.

Q. Will you tell us where that occurred?

A. That occurred in the conference room at Milwaukee Coin Industry.

Q. Was anyone else present to your recollection?

A. No, not that I recall.

Q. Will you tell us what was said by each of you at this meeting and what you did, if anything, in addition to talking?

A. I explained to Dave Nutting my concerns about the power devices and suggested to him that I could use a matrix multiplex to get around the problem.

Then I drew on the blackboard of the conference room the diagram that is in front of me, Exhibit 7.

Q. The diagram is Plaintiff's Exhibit 7.

Is Plaintiff's Exhibit 7 a reproduction of the diagram you drew on the blackboard at that time?

A. Yes, it is.

Q. When did you prepare Plaintiff's Exhibit 7 itself, if you recall?

A. I prepared this in conjunction with an affidavit that was

filed a couple of years ago.

Q. Was that affidavit filed in the United States Patent Office?

A. Yes.

Q. Was that in about May or June of 1981?

A. Yes.

Q. Did you show your blackboard drawing and explain your idea to anyone besides Mr. Nutting?

A. Yes, I did.

Q. Who?

A. I explained the idea to his -- another officer of the company, Dan Winter, and also explained it to another engineer, Duane Knudtson.

Q. What do you mean by cyclical or cyclical and sequential multiplexing in connection with your invention?

A. Well, the trick is to make the lamps look like they are constantly illuminated or, in other words, that they are all the same brilliance.

So it is important that they each get an equal amount of energy.

The way to do that is to give them their exact requirement a hundred percent of the time, which I was not doing. Now, we are multiplexing. So what I need to give them is -- for example, for a 16-mux lines, I need to give them 16 times the energy for 1/16 the time.

Now, in order to do that, you can give them 16 times the power, which I did, but then you must make sure they are only on for 1/16 the time. So the time slots associated with each column have to be similar or reasonably symmetrical. They have to be on, in other words, a constant amount of time. So that is the cyclical part of it.

Now, the sequential part of it is that you must go around all the columns before you go back and repeat a column. So if you did repeat a column twice, you would get too much energy and appear too bright. So you have to go through all the columns once and then come back and you can start repeating the column sequence again.

Q. By going through the columns, are you referring to a particular --

How do you go through the columns?

A. Well, you would turn on the columns sequentially one at a time, turn on column 1 first.

Q. Is there a name for the impulse you would use in turning it on?

A. You could call it a strobe. That would be a good name for it.

Q. All right.

A. So you could call it a column strobe, and then column 1 would be strobed for a 1/16 time interval, and then column 2, and then column 3, and then in sequence.

Then when you get done strobing all 16 columns, you go back and start at column 1 again.

It is very important that you do this fast enough that the lamps cannot see that 16 times the power, but they only see the average power; otherwise the lamps would burn out.

1-Q3

THE COURT: What is the 16 times part? I am not sure I follow that. 16 times what?

THE WITNESS: The lamps require a certain amount of power; like a light bulb in your car requires 12 volts to work. Well, in this instance here, we have a power requirement for these lamps. They require a certain number.

Now, if you want them only on for 1/16 the time, they are going to appear very dim. So in order to make them appear at their normal brilliance, you have to give them 16 times the power for 1/16 the time, and that comes out to unity power or their normal brilliance.

If you are going to keep them on for a very short time -- remember, this is happening very quickly -- the lamps will not have a chance to get very bright.

THE COURT: I see.

THE WITNESS: So you have to give much more power in order to make them appear bright.

THE COURT: I see.

BY MR. TONE:

Q Now, does what you said about cyclically and sequentially multiplexing apply to the switches as well as the lamps?

A Yes, it does.

Q In what way?

A Again, the switches have to be scanned in a period of time that we do not notice the time interval between checking

the switches. In other words, you have to check them.

Q. Does what you just said have to do with the concept or the term, real time?

A. Yes,it does.

Q. What does real time mean?

A. Real time is a concept of a process appearing relatively instantaneous to an observer.

Q. Would it mean relatively instantaneous within the logic of a particular circuit?

A. Well, it could be either to an observer or to --

For example, in a playfield, it would be -- the observing device would be the pinball itself. In other words, it has to be relatively instantaneous.

Q. It need not be a human observer?

A. No. It has to be to the device that it is responding to.

So we have to scan around the switches one column at a time and get back to a switch before in real time something can get in and activate the switch and leave again. So you do not want to have to -- you do not want to miss a switch.

So it is very important to scan or multiplex the switches fast enough to guarantee that you do not miss an activation of a switch.

Q. I left out one thing in this drawing. Would you come down again, and even if you have to draw it in the corner,

3

draw the solenoid, and just show how that ought to be depicted on that drawing.

A solenoid arrangement I should have said.

(Brief interruption.)

10-4

BY THE WITNESS:

A. The solenoids that I have used are in a "one of" configuration. For example, if there were four wires, only one of the four wires could be on at a time. So if there are four solenoids, only one of the four solenoids could be on at a time.

There would be four wires that would come out and go directly to four different solenoids. They can be drawn schematically as a little coil of wire.

BY MR. TONE:

Q. What are the wires coming out of, Mr. Frederiksen?

A. This comes out of a combination of a decoder, a one of four decoder, selecting one of these four wires, as well as the power device --

Q. All right.

A. -- necessary to drive that amount of current.

They can all be connected together to the power supply.

So we can selectively turn on device 0, 1, 2, or 3 here, but the solenoid array itself or the solenoid is not a matrix, and it is basically just an add-on to the matrix. It is there direct driven.

Q. All right. Would you tell the Court what a decoder is?

A. If this, for example, were a one of four decoder, you can bring in a number in the input here, a binary number or

10-4,2cbLB

computer number, representing the value 0, 1, 2, or 3, and that could in turn through electronic decoding select one of these four wires.

One of decoder means, though, that only one of the wires can be on at a time. If you turn on wire two and wire one was previously on, wire one is now off. So one of four decoder means that only one of the four wires can be on at a time.

11-1

Q. All right, please resume the stand.

Is there such a term used in connection with a pinball machine as logic requirements?

A. Yes.

Q. What does that mean?

A. When I had my discussions with Dave Nutting about pinball requirements, I had to worry about the electrical definition, in other words, the number of lamps and switches and digits --

Q. Which you have explained to us?

A. Exactly, and then further I had to understand what the logical requirements were for those devices.

In other words, if you see a switch, what do you do in response to that switch, and that is the logic of the machine.

In the electromechanical pinball machines, that consumed a tremendous amount of electromechanical logic.

Q. Did the logic of the machines have anything to do with the speed at which reactions occurred?

A. Yes, it would have some reaction to that. For example, since we are time division multiplexed, there is a problem that we have to get around quick enough to make sure we don't miss anything; whereas the logic in a pinball machine is random logic. There are different kinds of logic then.

We have the random logic or the logic that

11-1x,3cbCD

example, when you close a switch, you can apply power to a relay. It consists of a solenoid with contacts, and so the solenoid will pull in.

When the contacts close, they can be used to continue the closure. So once the switch activates the relay, the relay would stay closed forever. So that way you would memorize that that switch has been touched.

If you had, for example, on the Flicker pinball machine the A, B, C, and D targets hit, those four relays would be pulled in and would be memorized. Now, when all four of those, for example, are closed, they could have auxilary contacts on that relay, which could then be wired up to indicate that all four of them are now closed and could light another lamp, saying that you have a bonus now.

Now that is a form of a logic function. That is an AND condition. You have A and B and C and D, and that is one type of logic function.

Now, there are several other types of logic function, but that is one of the simplest to describe.

12-1

is dedicated to a particular function, a particular switch lighting a particular lamp, for example, and then there is the logic that is shared.

Now, it is not practical to do that in an electromechanical implementation, but it is practical to do that in electronics, and that is sequencing logic or sequencing or in their evolved form, actually microprocessors.

The difference there is that instead of having a separate piece of logic for every function on the pinball machine, they have a shared piece of logic that can be used by the different functions in time. The tradeoff there is that you can't look at that particular function all the time, and so it has to sequence around fast enough to make sure that it doesn't miss anything.

Q. The logic systems conventionally used in pinball machines in 1973 were what?

A. They were random logic.

Q. They used electromechanical relays, did they?

A. Yes, it was electromechanical logic, and it was random logic.

Q. What is the function of a relay, whether electromechanical or other relay?

A. It is probably best to explain that with a couple of examples.

A relay can serve as a memory device. For

Q. All right. In your development of a new pinball machine, what logical control systems did you consider?

A. All the systems we considered were electronic. But we started with the obvious replacement of random logic for the random electromechanical logic.

All this means is that you take every relay and replace it with an electronic chip that does the same type of logic. The only additions beyond the logic necessary, then, would be the power devices themselves, to make sure you could drive the same kind of power a relay could.

Q. And that would require numerous -- would require a lamp or, rather, a wire and a driver for each lamp and switch?

A. Yes, it would.

It is very impractical to implement anything like multiplexing an electromechanical system in a random logic that is all direct driven. In other words, there's a special wire for every lamp.

Q. The difference between that, I take it, and the electro-mechanical system would be that the relay would be a solid state device.

A. Yes.

Q. Would that system operate for more than one game or would there have to be a different set of hardware for each game?

A. As I said, that's an exact replacement for the electro-mechanical equivalents.

Every pinball machine has different requirements in general. Obviously, you could have a specific case where that would not be true.

So therefore you'd have to have different random logic for every game. And so the electronic logic also would have to be different for every game.

Q. In 1973 in the fall or early winter did you design any game using random logic?

A. Yes.

Q. What game was that?

A. It was the Safe game.

Q. When did you design that game?

A. In the -- that was in the first month or two at MCI.

Q. And did you complete a prototype of that game?

A. Yes, I did.

Q. Can you describe very briefly what the game was?

A. It was a secret agent type of a game that was supposedly trying to crack a safe. And it had electronic devices on it that were like electronic safecracking tools, and would give you beeps and meter readings to indicate whether or not you had succeeded in selecting a certain random number on the dial, as you were trying to crack the safe.

Q. What type of random logic did you use in the safe?

A. I used what they call TTL logic, or transistor-transistor logic. That was a random logic.

Q. I hand you what has been marked as Plaintiff's Exhibit 45-A, and I ask you what it is.

MR. TONE: Your Honor, I don't know whether this will mean more to you than it does to me, but I'm going to hand it up on the chance that you may want to see it.

THE COURT: Okay.

BY THE WITNESS:

A. 45-A is the wiring interconnection for the Safe game, and 45-B is the actual random logic electronic circuit diagram.

BY MR. TONE:

Q. Does either of these pages show what TTL logic looks like in schematic depiction?

A. Yes. 45-B does that. That's the actual schematic of the Safe game.

Q. When you studied the possible use of random logic for a pinball machine, Mr. Frederiksen, did you reach any conclusion as to its usefulness?

A. We did not wish to have to change an electronic package for every game, since we had to make printed circuit boards and whatnot, and they were very difficult to change for every game.

So we thought that maybe we could employ the

sequential logic instead.

MR. TONE: Before we leave random logic: I should say to the Court that we identified this exhibit for the purpose of having in the record a schematic depiction of a TTL logic system.

I don't plan to spend any time with the witness on it, but if your Honor has any questions, I would simply pause to --

THE COURT: No.

MR. TONE: -- to note that.

-2

BY MR. TONE:

Q You spoke then of sequential logic. And what is sequential logic?

A. As I mentioned earlier, sequential logic is the time-sharing of the same logic elements.

Q And what kind of sequential -- is there more than one kind of sequential logic?

A. Yes, there are.

In those early days logic sequence -- logic sequencers were actually manually built. We took several TTL parts and then constructed them with counters and what not to make sequencers.

Also, though, becoming available at this time were the microprocessor parts which were an advanced form of a sequencer.

Q And what did you decide to use?

A. For simplicity and for the fact that they were somewhat lower cost than the sequencers, we chose to use the microprocessor.

Q Before you made that decision did you look into microprocessors to see what their capabilities were and what their cost would be?

A. Yes, we did.

Q Tell us very briefly what you did in that connection?

A. At this time, by now we're in the early December --

we're going to have to step back a little bit -- in the summertime, before I started to work at MCI, I had worked with them, consulting on a video game.

In conjunction with that video game the chief engineer at MCI asked me to take a look at this Fairchild microprocessor part, and to see if it would be useful in conjunction with the video game.

After evaluating that part, I had decided that that would be very impractical. It was way too slow, and it was not oriented towards doing logic functions gracefully.

In the -- after I had first started at MCI, Duane Knudtson, their chief engineer again, had already arranged a meeting with National. And National had a microprocessor part that they were showing.

Actually, it wasn't a part; it was a complete board assembly. They had used their parts on their own electronic boards, and they wanted to sell us the entire board; which we couldn't afford to do.

And then later on in December we had Intel come in on a similar visit to the company, and they had showed us their parts, the 4004 microprocessor part.

Q All right. Before we get into your contacts, further contacts with Intel, let me ask a couple of other questions relating to the use of sequential logic.

Were there any problems in your mind at that

time peculiar to using sequential logic in connection with a pinball machine?

A. Yes, there was.

Q. Will you explain your answer?

A. The sequential logic requires that you go through, for example, all the switches and look at them in one or more at a time, but not all of them at once.

And so therefore you had to make sure that you did sequence around fast enough not to miss a switch.

And so the sequential logic trades off lower-cost hardware for timeshared hardware. You do have to make sure that you cycle fast enough.

Q. In connection with cycling fast enough, are solenoids a matter of any concern?

A. Solenoids are a concern, not from an activation point of view directly, but rather from the switch point of view.

If you didn't sample a switch fast enough, and turn around and turned a solenoid on quick enough, you might miss a ball. Especially in the thumper-bumper, that's that round thing in the middle of the Flicker pinball machine.

When the ball goes in there it rolls over that plastic platform on the bottom, and that closes a switch. If you're slow at responding to that switch the ball could bounce out of there a little bit before the plunger came down and kicked the ball, and so the ball would appear dead in

the playfield.

And that's a very bad response to have to suffer on a pinball machine.

T13

Q. Would you say that the system had to be fast enough to react in real time?

A. Yes, most definitely, but in this case real time is not a human observer but rather now the ball.

Q. Will you explain the relationship, if any, of a sequential logic system to your multiplexing technique?

A. Since the multiplexing technique by its very nature was sequential, you would start with column 1 and go on to columns 2, 3, 4, et cetera.

I thought that it would be very practical to use a sequential logic system to allow the time sharing of the logic as described earlier for sequential logic. So I thought that the multiplexing and the sequential logic would go well together.

Q. Now let's turn back to where we were with Intel.

You contacted Intel because they were selling a microprocessor or micro computer, is that right?

A. Yes.

Q. Was that called -- what?

A. That was the 4004 microprocessor system.

Q. You talked to some sales people from Intel, you said?

A. Yes.

Q. When was that?

A. That was around the second week of December in 1973.

Q. Before or after the conversation at the blackboard

with Mr. Nutting that you told us about?
A. This was after the conversation, about a week after.
Q. Who were the people from Intel?
A. The local representative was Bill Levine, and the factory representative was Phil Tai.
Q. Does Mr. Tai hold a doctor's degree?
A. I don't know.
MR. GOLDENBERG: Objection.
THE COURT: Overruled.
BY MR. TONE:
Q. Is he an expert in a particular scientific or technological field?
A. He was the factory representative for the microprocessor part, and he knew the microprocessor parts very well.
Q. Tell us the conversation you had with Mr. Tai and Mr. Levine at that time.
A. By this time now I was aware that I wanted to do a multiplexed matrix of lamps and switches and digits, and I asked Phil Tai the question, "How would you close a switch and light a lamp?"
At this time I still had really no idea how to use the microprocessor itself since when I asked that question previously of National, they couldn't answer it. The people at least there couldn't answer it.
Phil answered it very simply. He said you

just simply read a switch into the accumulator, into an input board to the accumulator, and then output it to an output board and light a lamp.

Well, after he explained that, it finally opened up my eyes a little bit, and then I told him what I wanted to try. I drew at that time a matrix similar to the one I had drawn for Dave Nutting on the blackboard again.

Q. I hand you Plaintiff's Exhibit 8, a document marked with that designation, and I ask you whether you recognize it?

A. Yes.

Q. Will you tell me who prepared it and the circumstances under which it was prepared?

A. This was a drawing that I prepared in conjunction with my affidavit a couple of years ago, depicting the drawing that I made for Phil Tai on the blackboard at MCI.

MR. TONE: Your Honor, I neglected to hand one up to you. We are going to talk about this.

THE COURT: Okay, thank you.

BY MR. TONE:

Q. The affidavit you referred to was the affidavit filed in the Patent Office that we mentioned a few minutes ago?

A. Yes.

Q. Look at Plaintiff's Exhibit 8 and tell me whether you

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drew all of that on the blackboard for Mr. Tai or only part of it.

A. I drew only part of this, the part including the seven segment decoder at the top to the right and a line going straight down from there, including the 1 of 16 mux decoder at the bottom.

-2

Q. What about the rectangle on the left, on which is written "Control Logic" and other notations?
A. After drawing the matrix on the board --
Q. First, did you draw that part?
A. No, I did not. Phil --
Q. That is in the original; as to the reproduction, you drew it all, right?
A. Yes.
Q. But you were depicting something that had been drawn on the blackboard, so we are inquiring whether in the blackboard version of this, you drew that rectangle on the left; you understand that?
A. Yes. Now, at that time I had drawn the parts on the right, depicting what I was intending to do, and Phil Tai drew the parts on the left, indicating how to hook up the microprocessor elements to the matrix.
Q. Can you explain to the Court, using Plaintiff's Exhibit 8, what Mr. Tai said about hooking up the microprocessor elements?
A. He explained that we need these particular parts, the 4004 microprocessor itself, which is the central processing unit or CPU, as it is abbreviated there. We need their read only memory, the ROM, which contains the program, and we would --
Q. Is the ROM a separate device, or is it embodied in one

chip?

A. It is actually a separate device. The CPU is one device. The ROM is a second device.

Q. Then the RAM is external to the CPU also?

A. Yes, that is a third device.

Then he said we may need a RAM as well.

He also showed that these elements had more than just their specific function. The ROM and RAM also had the input and the output ports on them, and then that is how you would connect up the lamp wires and the switch wires and the actual column decoder wires.

Q. What else, if anything, was said in substance during this meeting?

A. I had asked him if the microprocessor could scan fast enough to do the multiplexing. Again I was concerned about speed since I was afraid about missing switches or the lamps flickering. If we were to go too slow, the lamps would appear to flicker because you could see that period of time very clearly when they were on.

He said that he thought that they could, that it could go that fast.

That is where we left it.

Q. Did he say definitely whether in his opinion the microprocessor or the micro computer of Intel would satisfy your speed requirements?

13-2,3cbCD

A. He said he thought it could. He wasn't absolutely sure. It would have to be actually tried to find out.

Q. Did you discuss with Mr. Tai and Mr. Levine the possibility of purchasing Intel parts?

A. Yes.

Q. What was said on that subject?

A. I had asked him the question, like I asked National, if we could purchase the separate parts. National would not let us buy the separate parts. They wanted to sell us the whole board, but Intel said they would let us have now the individual parts so we could construct our own printed circuit boards.

Q. The parts you were interested in were what?

A. Primarily these three parts, the CPU, the ROM, and the RAM.

Q. The three parts depicted on the left side of Plaintiff's Exhibit 8, right?

A. Yes.

Q. What Intel model was then available?

A. That is the 4004 microprocessor.

13-3

Q. How did you leave things with Mr. Tai and Mr. Levine?

A. I asked him for further pricing information, and he left some literature with me at that time and I asked him for further literature to be sent.

Q. Did you come to any conclusion as a result of your meeting with Mr. Tai and Mr. Levine?

A. Yes, I did.

Q. What was that conclusion?

A. The conclusion that I came to was that the microprocessor was the answer and that it would probably work in conjunction with a matrix to complete the package that we were looking for.

Q. Did you have any conversation with any other person about that conclusion?

A. Yes.

Q. With who?

A. With Dave Nutting.

Q. Anyone else?

A. With Dan Winter, and the chief engineer was with me during this meeting, Duane Knudtson.

THE COURT: Are matrix and multiplexing synonymous as you are using them, or are they two different things?

THE WITNESS: They are not synonymous. You can actually have a matrix that is not multiplexed. For example, you could have something like a

series of lights that you just want to have only one light on at a time. That could be a matrix, and you could just simply apply power to one crosspoint.

BY MR. TONE:

Q. What is a matrix in this context, Mr. Frederiksen, limiting ourselves to that word?

A. As I have drawn on the paper, a matrix is a cross grid of wires. There is a horizontal wire that is called rows, and then there is a series of vertical wires called columns.

At the crosspoints you can place different devices. That is what is referred to as a matrix.

Q. The multiplexing then --

A. Is the way that you activate the matrix. If you, for example, turn on one row and one column to light up that intersection, to turn it on, that is not multiplexing; that is just simply a matrix without multiplexing.

As a matter of fact, it was used, I think, in one of the MCI games, a matrix without multiplexing.

Matrixing with multiplexing allows more than one lamp to be on at one instant in time. So it appears as though more than one lamp could be on.

That is basically the same thing as a matrix, but it is scanned very quickly. The time is so fast that the human eye can't see it.

THE COURT: You said a few moments ago that you

concluded that the microprocessor and the matrix were what you were looking for, if I heard you correctly, and that is what made me ask the question that I did. I was under the impression that it was the microprocessor and the multiplexing that you were focusing on.

THE WITNESS: Yes, again the microprocessor drives the matrix, and if it does it fast enough, it can appear as though it is multiplexing.

BY MR. TONE:

Q. I think the Court thought you might have just mentioned matrix without multiplexing, and the question was whether that was what you intended to say.

Is that your Honor's question?

THE COURT: Well, basically I just want to make sure I understand the terminology.

BY MR. TONE:

Q. Let me ask the question again as to did your conclusion relate to -- tell us the conclusion you reached again. Restate it. I may not have heard --

THE COURT: And I may have even misheard what he said, too.

MR. TONE: I am not sure. Your Honor may well be right.

THE COURT: Go ahead.

MR. TONE: I will ask him to state it again, if I

may.

BY THE WITNESS:

A. Well, the lamps and the switches and the digits do exist on the matrix, and so the physical framework that you hang all the lamps and switches on is the wire matrix.

The rate at which you scan it generates the multiplexing effect. So multiplexing is not a physical piece of hardware; it is rather a rate at which you scan.

Now, the electronics that drives the matrix, the microprocessor as we decided to use it here, I thought could at this time be fast enough to scan the matrix to make it look like it was multiplexed; in other words, not to have lamp flicker and not to miss some of these switch activations by being too sluggish or too slow.

So multiplexing and matrix do go hand in hand.

-4

BY MR. TONE:

Q. You told us Mr. Knudtson was at the meeting, and I think I neglected to ask you who was there.

Was anybody else there besides the four you have mentioned, yourself, Mr. Knudtson, and the two men from Intel?

A. That is all I recall.

Q. Did you later have a conversation about the matters you had learned from Intel with Mr. Nutting?

A. Yes.

Q. When in relation to the meeting with the Intel people?

A. I believe it was the following morning. I ran into his office and said that I had the answer, and I asked him to come over to the conference room and take a look.

Q. What was in the conference room?

A. I still had the drawings on the board of Exhibit 8.

I explained to him how the microprocessor could be used to connect the matrix up and to accomplish the multiplexing.

Q. How did Mr. Nutting respond to your statement? What did he say in substance?

A. He thought it was all well and good. I don't think he really understood it very clearly at that first exposure to it. He still had some concerns about whether or not the flickering would be visible or whatnot or whether or not the

13-4,2cbCD

multiplex would really work.

Q. I'm going to hand you three exhibits that are marked Plaintiff's 9, 10, and 11, Mr. Frederiksen, and if I may hand your Honor the original of those.

Will you tell us what these three documents are?

A. Exhibit 9 is a list of sequencer parts that I had given to Duane Knudtson to price out.

Exhibit 10 is a list of microprocessor parts that I had asked Duane Knudtson to price out.

Exhibit 11 is some of the answers that he got back from my requests that were depicted in Exhibit 9.

4-1

Q Do Exhibits 9 and 11 relate to the microprocessor or to something else?

A 9 and 11 relate to the sequencer, not the microprocessor that I was considering as an alternative to a microprocessor.

Q 10 relates to what?

A 10 relates to the parts of the 4004 microprocessor chip set that Intel had described.

Q No. 11 bears a date, 12/10/75.

You have said that is the pricing on the sequencer part?

A Yes.

Q When in relationship to Exhibit 11 was Exhibit 10 created if you know?

A Well, Exhibit 9 occurred about three days prior to our meeting with Intel, and then while Intel was in there, I had gone out and asked Duane to also price out these microprocessor parts.

A few days after that period of time, he came back with the answers from one of the distributors on the sequencer parts suggesting probably I did not want them any more, but here they were anyway.

That was Exhibit 11.

MR. TONE: I said, your Honor, 12/10/75. I should have said 12/10/73.

THE COURT: Yes. I see that.

MR. TONE: Your Honor has the original. So I think you can see it better than I can.

BY MR. TONE:

Q Did you subsequently order the sequencer for the Safe game?

A No.

Q Why not?

A The Safe game was a very simple logic system, and there has to be at least a certain complexity of logic to pay for the sequencer parts, which were a little expensive.

So we had elected to go with a random logic implementation for Safe.

Q Now, calling your attention to mid-December, did you have a conversation -- of 1973 -- did you have a conversation with Mr. Nutting on the subject of developing a specific game?

A Yes.

Q What game was that?

A The game that we had talked about in mid-December was the IQ Computer.

Q Was that also known as the Super IQ Computer?

A Yes, the Super IQ Computer.

Q Tell us briefly the conversation you had with Mr. Nutting on that subject.

A Well, Dave wanted to do a pinball machine. He also wanted to do the Super IQ Computer since he had done an

earlier IQ Computer with great success.

He had asked if we could now try the IQ Computer since he felt a little more comfortable with that. The pinball machine required a lot of very special devices, all these pot bumpers and side kickers and flippers and types of hardware that he still would have to purchase and was not familiar with thoroughly yet.

So he wanted to proceed with the IQ Computer. He had asked if we could then proceed with that on a random logic basis as well.

Q What did you say with respect to that statement of his?

A We had already gone through now a couple of months of searching for a relatively good system and had chose then to-- I had asked him if he would consider using the microprocessor multiplex matrix system for the Super IQ Computer.

Q Did you say anything about why you wanted to do it?

A Yes.

Diverting back to a random logic system now would have been a distraction for our ultimate objectives of trying a pinball machine.

Also, an IQ Computer was a simpler version of the same kind of a thing as a pinball was. It had about half the lamps and less than half the switches and digits. So it would be a good experiment in getting to the full-blown architecture of a pinball machine.

Q Did it have any solenoids?

A Yes, it did.

15-1pl

Q What conclusions came out of your discussion or discussions with Mr. Nutting on the subject of developing a Super IQ Computer game?

A Well, even though Dave thought that the microprocessor implementation would be a little more expensive, he agreed to go ahead with that architecture because of its long-term benefits.

Q I think it might help if you would describe very briefly what the Super IQ was, how did it look and how did it play.

A Well, the IQ Computer is a quiz game, and it consists of a filmstrip with several categories, for example, sports and theater and what-not.

And a player would select one of the categories, and then it would give you a series of slides. You'd select the answer to the slide as quickly as you could, and that would determine what score you would get for that slide. And it would go, sequence on and give you another slide.

Q In order to use a microcomputer for your games and to develop a system for using it, was it necessary to purchase any devices other than the microcomputers themselves?

A Yes. In order to develop, now, the IQ Computer, which Dave wanted to pursue first, I asked him if he could now get an Intellec machine.

An Intellec is a developmental system. It's a blue box that's about 2 feet wide, about a foot and a half deep and less than a foot high.

Q What is in the box?

A It's -- actually, it's a little computer. It consists of the 4004 microprocessor and some large amounts of memory to allow you to develop a program.

You could use this actually through its input and output boards on the back panel, to connect into your game and simulate the microprocessor elements as they would finally exist in the game.

Q After the user of the Intellec 4 developed the logic system and the program, what would then happen? What would he do about implementing what he had developed?

A Well, after the program was totally operational, you could punch out a paper tape to a connected teletype machine and send that to the manufacturer, and he would now actually print the actual ROM parts, very much like he would manufacture the other customer chips, or the other silicon chips, and then ship you your special ROM patterns, or your actual game program.

These are the production parts, and they're lower cost.

Q How much did a development system for Intel cost at that time?

A It was about $3,000.

Q Did you have a conversation with Mr. Nutting about whether to order a development system?

A Yes. When I'd asked him to proceed with the project, with the microprocessor instead of random logic, and that we should order the developmental system, he was still a little apprehensive. And he said, "Well, are you sure this multiplexing really is going to work?"

And he was at that point in time reluctant to order the developmental system.

Q What -- we are now in what approximate time frame, Mr. Frederiksen?

A This is still around the middle of December, or towards the end of December now.

Q Of 1973?

A Yes.

Q And what if anything did you do after Mr. Nutting expressed reluctance to spend the money for the developmental system for the Intel 4004?

A Well, his concern was still the multiplexing, as I explained.

And so I prepared a demonstration for him. And the demonstration was to show him that multiplexing would indeed work, and therefore it would not be a risk.

Q What did the demonstrator consist of?

A I had eight lightbulbs placed on one row, and then I sequentially activated those eight lightbulbs.

Q At the request of counsel did you reconstruct that demonstrator in substantially the same arrangement that you built for Mr. Nutting at that time?

A Yes.

Q Is the original one still in existence?

A No, it isn't.

Q And in preparation for trial we asked you to build one. Is that right?

A Yes.

Q And is that in the courtroom?

A Yes, it is.

Q Is that the device that is placed on the table to your left and marked Plaintiff's Exhibit 328?

A Yes.

15-2

Q You can take my word for the exhibit number.

Would you step down to this exhibit and describe it to the Court and demonstrate it.

A This is a series of, a very simple experiment, of just eight light bulbs representing just one row in the matrix.

Again, in the actual matrix we had 16 long, not just 8 long, and there was 4 rows of lamps; but you only had to just see one row to get an idea of the multiplexing concept.

Now, these are the lamps that are used in the games. They're No. 27 bulb, which is the same one that is used in the pinball machine.

I then connected them to a series of power transistors, over to a little piece of logic system which was a 1-of-8 decoder, that was activated by a timer circuit, that allowed me to control the time rate at which they were activated. So I could slow them down and speed them up and see the effects of the different scanning rates as to how fast it had to go to fool the eye.

I called Dave Nutting in to take a look at this -- it's going to take a little while for the transistor to get warm -- I called Dave Nutting in to look at this, and had it in this condition when he came in to the lab.

Q This condition being that all the lights appear to be lit?

A Yes.

This demonstrator is a little more ruggidized than I had it in the lab. The wires were kind of dangling a little looser than this, but I had to button them down a little bit in order to make them travel.

Then when he came into the lab I asked him, "Which light bulb is on? There's only one of 8 on."

He says, "Well, they're all on."

And I said, "No, they're not," at which point in time I started turning down the speed.

Now, I have to turn the power down, too, since I said, if you go too slow, the lamps could burn out with that much excessive power.

When I slowed it all the way down, he could see that indeed only one lamp was on at a time. And then we sequenced through the lamps.

Q Show us how -- all right.

A We could increase the speed again, and you can see now that the filaments are starting to blow a little bit and lasting a little longer.

Now they're at a point here where they're still flickering; we had to be faster than this in the multiplexing.

And finally you come to a speed where that flickering is not visible.

Q Approximately what is that speed?

A Somewhere around 60 cycles per second; all the way through the whole array at 60 cycles per second.

Now you can safely turn the power up, and you can see that the lamps appear to be constantly illuminated; but they're actually not. They're only being lit one at a time.

Now, that proved to Dave Nutting that multiplexing worked, and at that point he said, "Okay, go ahead and order the simulator."

Q Then did you proceed to order the developmental system?

A Yes.

Q And that's call an Intellec 4. Is that right?

A Yes.

Q Or it was at that time.

A That's correct.

Q I take it there's a newer version of it at the present time?

A Yes, there is.

Q Or at least one came later.

When did you order the Intellec 4 development system?

A Right after this demonstration. That's about January

15th.

Q When did you receive it?

A Around the first week of April of 1974.

Q Referring to the period December 1973 to April 1974 and the time in April when you received Intellec 4, what did you and Mr. Nutting do in furtherance of your development of a microprocessor controlled multiplex matrix game apparatus?

A Well, we did several things.

Mr. Nutting worked on a larger digital display for the seven-segment displays that were necessary for the games than were presently available from the manufacturers.

I had worked on evaluating an existing pinball machine to determine some of its characteristics. And then I had also prepared some --

15x

Q Before you go on, where did you get the existing pinball machine?

A The pinball machine that we had was the Flying Carpet from Dave Nutting's basement.

Q Do you happen to know what manufacturer built that machine?

A I believe that was Gottlieb.

Q What did you do with that machine?

A We brought the machine into the lab and then hooked up an oscilloscope to it, which is a time-measuring device, and we actually measured the responses of some of the solenoids and the switches to get an idea of what it was all about.

Q What were you measuring when you measured the solenoids and the switches?

A When we measured the switches, we were trying to find out how fast could a switch close and open, since a pinball could make that happen very quickly.

We also tried to measure how long the solenoids had to stay closed for them to perform their proper activation. All the different solenoids had some different timings. The pop bumpers would operate very quickly whereas the chimes were considerably slower.

Q What else did you do during that period?

A Dave Nutting had finally finished his digital displays,

and he tried displaying those on top of the pinball machine to get an idea of how they would look.

Q Were those digital displays designed for any particular game or device?

A Well, he was primarily concerned with the pinball. That is why they were the size they were, since the small half-inch displays could not be seen readily from the front of a pinball cabinet. The back box is several feet away from your eyes.

That is primarily the reason he made it, but it could be used with other games as well such as the IQ Computer.

Q Referring particularly to the Intel system, the Intel manuals, did you do anything during this time period, December to April, with reference to the Intel system?

A Yes.

Q What did you do?

A Right after I received the literature from Intel, I started studying the literature.

Q Did that include a manual or manuals?

A Yes. There was a user's guide.

Shortly after that, I prepared a couple of forms to simulate on paper the microprocessor parts, specifically the CPU and the RAM.

Q When you read the user's manual, what was your purpose

in reading it? What were you attempting to learn?

A Well, by this time I already knew what I wanted to try to do.

The primary reason for reading the manuals was two-fold: First, to find out how to electrically connect up the microprocessor parts.

The second reason was to understand the programming language of the microprocessor so I would know how to program it.

Q Did the manuals tell you how to use a microprocessor to control a pinball machine?

A No, they did not.

Q Did you do anything with respect to architecture?

A Yes.

16-2

Q Can you tell the Court what architecture means in this context?

A Well, the architecture is actually the way that you wire up the different parts. We draw those drawings up to show us how we want to wire them up in things called schematics like we had shown for the Safe game.

The architecture I had in mind basically involved the matrix and the microprocessor parts and how they were interconnected to accomplish the task.

After I had read the manuals to figure out how to wire up the microprocessor parts themselves, what their electrical requirements were, then I had actually prepared some schematics on how to actually build the machine that I had in mind.

Q You spoke, I think, of connecting the microprocessor control system with the matrix?

A Yes.

Q What does the term, interface, mean in this setting?

A Well, basically the microprocessor parts are a very low power, and you need some interfacing parts, such as decoders and power devices, to match up the microprocessor now to the actual wires in the matrix.

Q Did you work on interface circuitry during this period?

A Yes. I worked on the computer drawings and on the interface circuitry itself, which actually comprised the

total schematics for what I was intending to do.

Q Did you do anything with respect to programs?

A Yes.

Q What did you do?

A I had prepared these forms that gave me an idea of all the different registers and things inside the RAM and the CPU, so that I could try writing some programs.

I did not have the developmental system yet, and so I could only experiment with the paper simulations.

Then I started programming the first thing, the mux routine itself, the multiplex routine.

Q When you use the term, mux, does that refer to the multiplex?

A Yes. It is an abbreviation for multiplex.

I started developing the mux routine first and had written up several pieces of program elements during that period of time.

Q Can you tell us when during that period of time that occurred?

A That is in the January-February-March time frame.

Q Tell us why you evaluated the -- why you measured the switches and evaluated the characteristics of the Flying Carpet machine?

A I was concerned about what was necessary to program the sensing of the switches. I did not really have much

prior knowledge about pinball machines, and I had to get that knowledge. The only way to do that is to physically take a unit and to measure it.

Q Did you consider the matter of accurately detecting switch reactions? Did that have anything to do with your measurement of the switch reaction?

A Yes. As I had mentioned a little earlier, the multiplexing, if it was not quick enough, could miss a switch if it happened too quickly.

Our measurements were to determine the length that a switch would stay closed.

For example, a target switch, which is probably one of the fastest-acting switches as exists on the Flicker there -- as the pinball hits it at a very fast velocity, since it is a pretty fast-moving projectile, it could bounce off the switch so fast that the closure may not be sensed if we did not scan quick enough.

So I had to know how fast it could, for example, bounce off a target switch or how fast it had to act not to bounce out of a pop bumper for the pop bumper to be activated and kick the ball.

Q Do you recall the answers you got, or can you give us something on the order of magnitude of the speed of the switch closure?

A They were of very short time durations. They did

vary depending upon what the switches were in the -- around the 20-to-40 millisecond rate at the shortest.

Q That is 20-to-40?

A That is thousandths of a second. A millisecond is a thousandth of a second.

16-3

Q Did you reach any conclusions with respect to whether the matrix multiplexing arrangement would work on the switches as a result of your evaluating and the work you did during this period?
A. Yes.
Q What was the conclusion?
A. I concluded that we could multiplex fast enough not to miss even the fastest switches that were occurring on that game.
Q You told us you received the Intellec 4 in April of 1974.

When you received it, what did you do?
A. Well, the first thing that I did was to try some of the sample programs that I had been writing over the last couple of months. We had installed the -- I put in, first of all, the mux routine and tried that out to see how it worked in some of the other routines.
Q In that mux routine, multiplexing routine, I take it that means?
A. Yes.
Q How many lines did you have?
A. All the original software was for 16 mux lines.
Q Did you need 16 lines for the Super IQ Computer game?
A. No, I did not.
Q Why were you using 16 lines at that point?

A. Well, the reason I was using 16 lines is that our intention for this hardware was ultimately to be a pinball machine. and it was the only machine, as a matter of fact, that ever did need 16 mux lines. But I had to make sure it would work for that case.

The pinball machine is a worst case condition. It is the only machine that at the time was even in that class. So we wanted to make sure that this architecture would fit in even that worst case condition.

Q The worst case condition referring to the number of lines that were required?

A. Yes, the number of lamps, the number of switches, and the number of digits.

Q Hence, the number of lines?

A. Yes.

Q Lines, of course, refer to the horizontal wires on the sample chart you drew?

A. No, the number of lines -- referring to the column, the number of vertical lines.

On a pinball machine, we would want 16 of those column lines.

Q Of the vertical lines?

A. Right.

Q I am glad I asked that question.

A. On the IQ Computer, we would only need 8 or about half

that size.

Q. All right.

A. So an IQ Computer could be looked at as a half-size pinball machine.

Q. What else did you do with particular reference to the Super IQ after you got it, if anything?

A. I began work on the Super IQ Computer then after we had tried these experiments.

Q. I'm sorry. I misspoke, Mr. Frederiksen.

I meant what else did you do with the Intellec 4 machine before you turned back to the Super IQ development, if anything?

Have we covered that now?

A. Yes. We have covered all that.

Q. Now, did you apply that Intellec 4 to some particular game?

A. Yes.

16-4

yes

Q. What game?

A. The Super IQ Computer.

Q. Tell us what you did.

A. We had already designed an interface card by this time, interface electronics, to hook up the back side of the Intellec developmental system to the IQ Computer.

Dave Nutting and I now sat down and talked out where we wanted to specifically place the lamps and switches on the mux chart. A mux chart is a chart representation of the wire grid.

Q. Is it a chart similar to this exhibit that you have drawn on the 4, 384, the larger version?

A. No. It is more like grid paper itself. It is actually squares where we can label in things, but it is in that grid configuration.

Q. There is one of those charts in the patent itself, I believe, is there not?

A. Yes.

Now, before I could write a program, we had to now assign those positions in the matrix, so I could now write the specific probram.

So we sat down and assigned a matrix and put the lamps and the switches where we wanted them, and then I went back and started writing the program.

Q. What were the considerations in placing the lamps and

switches? You said you, "put them where we wanted them."

Were there any parameters that you used in determining where to put them?

A. Well, there are some. For example, the matrix lays down like a sheet of paper, very much like on the drawing. So you would want to keep the lamps in a similar physical orientation, so the lamps that were in the same area would go to the same columns.

So we had that in mind.

Q. What else did you do?

A. I began writing the program at this time while Dave Nutting prepared the cabinet and while the technician, Paul Smith, prepared the interface electronic card itself.

Q. At that time how many employees did Dave Nutting Associates have?

A. I do not recall.

Q. Well, how many of you were working on this project, three or more?

A. Just the technician and myself and Dave Nutting.

T17

Q. What were you doing while Mr. Nutting designed the box and the technician built up the interface that had been designed?

A. Pardon? What was that?

Q. What were you doing while the others were doing the tasks you just described?

A. I began writing the actual program for the IQ Computer.

Q. What were the results of your work on the Super IQ Computer game?

A. The results of the work were an IQ Computer game that actually functioned, and it was tied to the Intellec 4 development system through an umbilical cord, which is a wire connecting it to the box.

Q. The box was someplace outside the game, external to the game?

A. Yes.

Q. Did you ever test that game for noise?

A. No, we never did.

Q. Why not?

A. Well, at this point in time it wasn't in a configuration that we ultimately intended, and so it didn't seem like it would be reasonable to test it for noise. The noise measurements wouldn't have had much meaning unless it was in a final form.

Q. The final form being what? Can you be more concrete?

A. Yes, we had actually drawn up the final form before we began, so we knew what we were targeting at. The final form is similar to what is in the Flicker right now. It is the microprocessor system on a board, self-contained inside the box.

Q. As distinguished from being connected by an umbilical cord or cable but external from the box?

A. Yes.

Q. What, if anything, did you do with the model of the Super IQ game you built?

A. We demonstrated it to Midway/Bally.

Q. By the way, when did you have it ready for demonstration?

A. It was demonstrated on June 24, and it was ready for demonstration a few days earlier than that.

Q. What was the condition of the game at the time you demonstrated it with respect to whether the control system was external to the game box?

A. The Intellec 4 was external. We had placed the whole thing in the conference room. We had the Intellec 4 external, along with the teletype with that, and the umbilical cord connected over to this IQ Computer game now, and the actual electronics was in the game itself. The interface electronics was in the game with the power supply.

Q. Will you name the persons from Bally to whom you exhibited the game?

3

A. We showed the game to Hank Ross and Marcine Wolvertin of Midway Manufacturing and to Joe Robbins of Empire Distributing.

17-2

-ting Q Are those companies subsidiaries of Bally Manufacturing?

A. Yes, they are.

Q How did the game work?

A. It worked fairly well, though the lamps were a little dim.

Q Did anyone mention that as a complaint?

A. Yes, Hank Ross mentioned that the lamps were dim.

Q What else, if anything, did the Midway and Empire people say about the Super IQ game?

A. Besides the fact that the lamps were a little on the dim side, they said that they were not interested in the IQ Computer game at this time.

Q As a result of that position on their part, what did you and Mr. Nutting do with the IQ Computer game you had built?

A. We terminated the project.

Q What did that mean? What did you do with the program and so forth?

A. Well, I went back to my work area and heard later on that they had decided not to go ahead with the IQ Computer, at which point in time I dumped the program. That means that I actually took the machine language program and printed it out to the teletype terminal.

Q I am going to hand you a group of exhibits, marked Plaintiff's Exhibits 17 through 23, and ask you whether you

can identify them.

These are the originals, your Honor.

Will you go through them, Mr. Frederiksen, and tell us what they are?

A. Exhibit 17 is the microprocessor part of the two forms that I had prepared for paper simulation. This gives you an idea of what is inside a microprocessor as far as assigning its resources.

Q. Did all these relate to the Super IQ Computer?

A. Yes, this is some of the assignments that I used in conjunction with the IQ Computer.

Exhibit 18 is a drawing of the production version of the Bally Brain, but it was at this time not called the Bally Brain but its equivalent that I intended to use in conjunction with the IQ Computer.

Q. It is labeled "Logic Diagram"?

A. Yes.

T18

Q. And is that a part of the -- can you describe it any more particularly than you have? What was the Bally Brain?
A. Well,this was not called the Bally Brain at this time.
Q. All right. What was it -- or, whatever it was called, what did it consist of?
A. Basically consisted of 4004 microprocessor part in the right side there, and it has some of the ROM parts, the 4011, a pair of those, and there's a 4002 RAM part shown on here as well.

The rest of the circuitry is basically housekeeping type of stuff necessary to make the microprocessor work.

On the top is a clock circuit, that's the whole top of that thing.
Q. Tell us what the housekeeping circuitry was, briefly.
A. Well, we have -- on the top of the thing, of the schematic, is a clock circuit, which generates the pulses necessary to sequence the microprocessor.

On the left side of the schematic is the power supply necessary to give the proper voltages to the microprocessor to make it work correctly.

The actual microprocessor elements were just those four parts.

At the bottom of the schematic are some of the decoders that were used; it used one-of-sixteen decoders.

Q Are those the ones, DD, DA?

A. No. One the far left side, F-9 is a one-of-sixteen decoder, and F-11 is a 7-segment decoder. That converts a binary number into a 7-segment displayable number for these digital displays.

Q Are the F-10's decoders also?

A. The F-10's were output devices, and they drove the lamp lines. They were just memory device, latches.

Q Is this what -- could this properly be called hardware?

A. Yes. This is the logic portion of the hardware. This does not include the interface circuitry, the power devices, but it does include the logic portion.

Q Turn now to 19 and tell us what that is.

A. 19 is a program from the 4004 that was done very early in conjunction with the IQ Computer.

Q And 20?

A. 20 is a later version of that program, now more fully developed. In fact, this is pretty much the condition of the program at the time of the demonstration.

Q And 20 and 21?

A. I'm sorry, I lost sequence. I thought when you said 20, I was referring to 21.

Q I'm sorry --

THE COURT: 21 is a multi-paged exhibit.

BY THE WITNESS:

A. 21 is what I was referring to as far as the program.

(Brief interruption.)

BY MR. TONE:

Q. All right. I missed -- I think Mr. Lynch points out that I think I -- that I said 20 and you answered with respect to 21.

A. Yes.

Q. Let's take a minute to go back and straighten it out.

You told us accurately I think what 19 is, right?

A. Yes.

Q. Tell us then what 20 is.

A. There is no 20.

Q. Well, then, that's my omission, and I -- one must have been left out of your set.

Here it is.

MR. TONE: Does your Honor have 20?

THE COURT: I do.

BY THE WITNESS:

A. There is a 20.

BY MR. TONE:

Q. Tell us what it is.

A. 20 is a chart that is very similar to the Exhibit 17, but now for the RAM element rather than for the CPU.

And this is how I allocated resources in the

RAM to make sure I didn't put numbers on top of each other. This was the second form that I had used in conjunction with these paper simulations.

Q And 21 is what?

A 21 is the program as it existed at around the time of the demonstration of the IQ Computer.

Q And 22?

A 22 is the same program with some additional annotations, probably some last minute corrections to the program.

Q And 23?

A 23 is the actual machine language program; although not very attractive, is the way that it is inside the computer, that I finally dumped out to keep a record of the state of the machine at that day of demonstration.

Q By dumping it out, you mean preserving it.

A Yes, printing it to the teletype machine.

Q And did all of these documents, 17 through 23, relate to the Super IQ Computer?

A Yes, they do.

Q On 23 there's a notation at the top. Is that in your handwriting?

A Yes.

Q What does it say?

A "The Super IQ Computer project terminated 6-24-74."

Q When did you write that?

A. I would assume that it was on that day. That was the day of the demonstration.

I wrote that on there right after I had heard that the project had been terminated, from Dave Nutting.

Q. All right. What happened next at Dave Nutting Associates?

A. We began working immediately on the pinball machine.

Q. And will you tell us, will you compare the work that had been done on the Super IQ Computer and the work that was required to develop a pinball machine?

A. Well, as we had originally intended by selecting this particular architecture, or this particular electronic package for the IQ Computer, was as a kind of a prelude to the IQ -- or, to the pinball machine.

And so there was a lot of similarity.

We reverted, now, back to the 16 mux lines. We had cut it back to 8 mux lines for the IQ Computer, but now we have to revert it back to 16 mux lines for the pinball machine.

The multiplex routine was copied over pretty much intact for the new program.

And then we began developing the architectures and the programs, now specific for the pinball machine.

18-2

Q Did the Super IQ have parts similar to the parts that were in a pinball machine?

A Yes.

Q Were there any changes in the location and affiliation-- and working place of -- let me start over again.

Were there any changes in the location of the working place or in your employment at about that time?

A Yes, there was.

Q And what was done?

A Milwaukee Coin Industries was now phasing down at this time. And Dave Nutting split off to start a separate group called Dave Nutting Associates.

And we moved our facilities -- and asked me to join him, by the way -- and then we moved our facilities around the corner to another MCI facility, an old assembly plant.

Q Was Milwaukee Coin Industries going out of the game manufacturing business at that time?

A Yes, they were.

Q I have been referring occasionally up to now to Dave Nutting Associates. For the time period up to the end of June 1974 I should have been talking about Milwaukee Coin Industries. Is that correct?

A Yes.

Q Dave Nutting Associates actually was not formed until

about the end of June or the first of July, 1974. Correct?

A That's right.

Q And when I have referred to Dave Nutting Associates with respect to the earlier period, did you understand that I meant the shop where you were working and the people you were working with?

A Yes.

Q Where geographically was the new location?

A It was just around the corner from where we were at. As a matter of fact, it was a back room that was one of their older assembly areas that we had taken over.

Q "Their" referring to Milwaukee Coin?

A Yes.

Q Did you and Mr. Nutting interrupt your work during the move?

A No. We had continued to design the pinball specific game that we had in mind at that time.

We spent a lot of day time moving a lot of our materials over to the new plant, which was just down the alley. It was like out one back door, down the alley into another back door.

Then, during some part of the day I worked on the programming that was required.

Q What kind of hours were you working in those days?

A Well, that was a very tedious time. A typical work-

day was 14 to 16 hours.

Q Describe the new premises, the premises to which you moved. They weren't new, I take it?

A No, they were far from being new.

It was in an older part of Milwaukee; it was almost of the warehouse nature. They had set up some workbenches in there where they had used for assembly.

We had to strip out that place and we had to flush it down and repaint it and put a couple of walls and whatnot so that we could establish our offices over there.

Q Will you now describe the work you did, starting with the time you terminated the Super IQ project, which I think you said was June 26 -- tell us what you did from then on, you and Mr. Nutting, in connection with the development of a pinball machine.

A Well, the first thing that happened is, we started talking about what particular pinball idea we wanted to implement.

We had come up with some novel features that would be kind of neat on a microprocessor pinball architecture like ours. And then began building a simulator for that.

Q Well, you mentioned novel ideas. What were the ideas you referred to, the neat ideas?

A One of the novel ideas was to do a tournament pinball machine, very similar to like a bowling tournament, where you could accrue scores, include more than a single game.

For example, we could have like a three-game series.

Q Did you actually build that into the machine you built?

A No, we never did.

Q Were there any other ideas of that nature that you can think of right now?

A No.

Q What else did you do?

A We designed a simulator to use for developing the pinball machines on.

Q Who designed the simulator?

A Well, the concept of the simulator is something I designed. It was basically just a series of windows, lighted windows, that you could use to actually simulate the actual elements in the playfield and a bank of switches that you could use to simulate the switches on the playfield.

But then Dave Nutting actually designed the cabinet itself and built the display device which was quite large.

Q Who laid out the circuitry --

THE COURT: Mr. Tone, why don't we take about a

18X

19-1pl

ten-minute recess.

MR. TONE: Very well, your Honor.

(Brief recess.)

MR. TONE: Mr. Frederiksen, will you resume the stand?

(Brief interruption.)

BY MR. TONE:

Q We were talking about the simulator, Mr. Frederiksen. Did the simulator have switch lines in it?

A Yes.

Q Did the simulator simulate a switch responding to a ball contact in a pinball game?

A No, that was not its intended purpose.

Q What was its intended purpose with respect to that?

A Its purpose was to work out the logic of the program; in other words, just to give us a switch closure to allow the program to cycle through to check its performance. It would not check it in real time. You couldn't operate a manual switch that quickly.

Q It would not, for example, reflect or show the amount of time that a switch stayed closed in an actual pinball game?

A No, it wouldn't.

Q It wouldn't show anything called switch bounce, which we haven't come to yet, but we will?

A No, it didn't.

Q I am not sure that the purpose of building this simulator is entirely clear at this point. Can you tell us why you did this as a step in developing the invention?

A Yes, at this point in time I had a blue box and a IQ Computer. The blue box is a simulator, as we called it, and the IQ Computer, and I had no pinball machine.

So I needed to start developing a pinball machine. In order to do that, I had to have something of that capacity.

It is very cumbersome to take the glass off and work on the pinball itself if you had one, but I didn't have one. So I needed something to simulate a pinball machine.

So I used a lighted back box arrangement, an array of 64 lights on large boxes that each light would illuminate a box that was about 2x2 inches.

Q Each light would be represented by a little window, which could be illuminated?

A Yes.

Q Would that be a way of saying it?

A Yes, this was translucent plastic that I could then grease-pencil as to what the lightbulb represented. So in that way I could assign -- also the light bulbs were in an array, just like the matrix was. So it was like a

physical embodiment of the multiplexing charts that we were filling out, and I could then go ahead and grease-pencil in the assignments and hook it up to the simulator.

Q When you would grease-pencil in an assignment, would you tell us with respect to a particular window what that means?

A Let's say that we chose target switch A to be on column 1 and lamp row 1. At that crosspoint or where that window is, I could then label that window target A. So I would know that is the lamp that lights up when you hit target A.

Q What did you use this simulator for?

A I used it to develop the actual program that was to be ultimately used in the pinball machine.

In the beginning, though, we only used it to develop some of the general pinball routines since I didn't know yet what specific pinball I had to implement.

Q Did the simulator, in addition to having 64 lamps, have 64 switches?

A Yes, it did.

Q And 16 digits?

A Yes.

Q In addition to work on the simulator and developing the program, what else did you do during this period after late June?

A As I mentioned earlier, I had reconfigured the archi-

tecture now back to 16 mux lines, and we had drawn up by this time now the actual target machine or the production computer that we had intended to implement, which subsequently would be simulated with the Bally Brain, and had developed the interface hardware for the simulator and also drawn the interface hardware necessary to hook up to the actual pinball itself.

19x

Q. How did the circuitry you designed compare to the circuitry of the Super IQ Computer?

A. Except for the fact that the Super IQ Computer had only 8 mux lines and the pinball required 16 mux lines, they were identical. They had the same number of rows of lamps, and the switch rows were similar to the best of my recollection, and they had fewer digits, but they had one digit row as in the Flicker game.

So the matrix was very similar, very similar, and the hardware was also very similar.

Q. You have told us that you did work on programs. YOu have described that.

Is there anything you wish to add to that?

A. No. That is all we did. We worked on the program material at that time until the pinballs arrived.

Q. I show you a document marked Plaintiff's Exhibit 15.

Can you identify that document?

A. Yes.

Q. What is it?

A. This is a sketch of the digit hook-ups for the Flicker machine.

Q. Who prepared it, if you know?

A. This was prepared by Duane Knudtson.

Q. In connection with what project was it prepared?

A. It was prepared in conjunction with the pinball project.

Q When were they prepared?

A. The date on the document is 6-30 of '74.

Q. That is the date on one of the sheets, right?

A. Yes.

Q There is a word on the first page, Tournament.

What does that mean?

A. Well, this was the novel feature I had talked about earlier where you could accrue a series of games very much like a bowling tournament.

Q Did you ever apply the work that is reflected in Plaintiff's Exhibit 15 to a real pinball game?

MR. GOLDENBERG: Mr. Tone, I apologize for interrupting, sir.

I note the copy that we have been furnished is apparently missing page 2.

MR. LYNCH: Page 2 is on the opposite side.

MR. GOLDENBERG: Then I do apologize for the interruption and for the failure to --

MR. TONE: It is quite all right.

BY MR. TONE:

Q Did you ever apply the work to a real pinball machine?

A. Yes.

Q Was that a Bally Flicker?

A. Yes.

Q How many of those did you work with?

A. We worked with two Bally Flicker machines.

Q. Where did you get the Bally Flicker machines?

A. They were shipped to us from Bally.

Q. Do you recall when you received them?

A. Around the first week of August or the latter part of July of 1974.

Q. What did you do with those machines when you received them?

A. Well, the one machine we kept as a control. We did nothing with it but, rather, used it to keep ourselves reminded about the logical functions we had to perform.

The second machine, though, we completely gutted it out and then took out all the electromechanical workings and piled them up on a table and took a picture of that to demonstrate how much equipment this Bally Brain could replace.

20-2

Q. Is the machine on the right here in the courtroom, which you have had a chance to examine earlier in the day, marked 333, the actual Flicker machine that you gutted as you have just testified?

A. Yes. That is the machine we had.

(Brief interruption.)

BY MR. TONE:

Q. I hand you Plaintiff's Exhibit 26-B, and I ask you whether that is a picture of the parts taken out of the machine.

A. Yes, it is.

Q. Did you take that at the time you gutted the machine?

A. Yes, we did.

Q. What did you do then?

A. Well, several things happened at this time.

Again, Dave Nutting and I sat down now and assigned the final mux table.

Please understand that in order to program a m achine, I have got to know where every lamp really is, not just about where it could be put.

So we had to now fill out the mux table again, just like we did with the IQ Computer.

We went through the physical locations of the lamps and what not on the playfield and figured out what would go with what. We got the mux chart all filled out as to where the lamps and switches and solenoids would go, and

then I began programming now the actual Flicker pinball, which was now peculiar to the Flicker logic.

By this time we have already had the interfaces designed that were necessary to hook up the Flicker to the IQ Computer, and we also had designed the prototype computer called the Bally Brain now.

Dave Nutting then proceeded with actually wiring up the playfield. He had installed all the lamps and all the diodes and the wires necessary to hook up the matrix. While he prepared that, Paul Smith, our technician, began wiring up the interfaces, first the one that hooked it up to the Intellec developmental system, and, secondly, the actual Bally Brain itself, which took the program elements directly.

I continued working on the program during this time.

A short time later, this was all completed, and we hooked up the Intellec now actually to the Flicker itself.

T21

Q Did you -- by what means did you hook up the Intellec 4 to the flicker?

A This first hook-up was an umbilical cord hook-up, very similar to what we had for the IQ Computer.

Q With the Intellec 4 external to the pinball machine and not in the box?

A That is correct.

Q What did you do after you cabled the Intellec 4 to the pinball interface circuitry, using the, what you called the umbilical cord, I think?

A Well, the first thing I did was to check out the interface with a test program which flashed all the lights alternately, like a checkerboard, and it kicked all the solenoids in sequence.

This allowed us to make sure that all the interface circuitry was working correctly.

Then right after that I began actually turning on the program elements themselves that had been developed on the simulator up to this point in time. Now the simulator box itself was no longer needed, it was disconnected in this period of time.

And I actually now evolved the program on the Flicker pinball itself.

Q What were the initial results of your work? Now we're at the point where the Intellec 4 is hooked up by

the cord to the machine.

A Well, the initial results were that the program developed now to a point where the Flicker really kind of worked the way we had hoped it should and simulated the Flicker pinball pretty well.

At this point I made a first copy of the program and plugged this now into the actual Bally Brain that's in the machine today, and put that into the Flicker pinball and cut loose now for the first time the umbilical cord.

At this point I hooked up the simulator again and began final game tuning on the simulator rather than on the Flicker itself, while the Flicker was being simultaneously tested for game play.

Q I think we've already described the Bally Brain.

Will you describe it with specific reference to its use in a computer? I think we talked about it in connection with the Super IQ game.

A Well, I showed you the Bally Brain earlier --

Q Right.

A -- this is actually the logic portion of the Flicker machine itself.

It does have the program PROMs on-board, these E-PROMs that I could plug right in front of the Intellec machine and program there directly myself.

And so after the game was at a first initial level, I prepared these E-PROMs and plugged them into the board, and then plugged the board into the Flicker as it exists today, as a beginning point.

And that board basically is the logic for the Flicker machine. It's all the intelligence for the machine.

Q And you put it in the back box of the machine where we saw it earlier today. Is that right?

A Yes.

Q 25-A and 25-B are pictures, photographs. Tell me what -- I'll hand the Court the original and hand you a copy -- will you tell us what those are?

A 25-A is a picture of the Bally Brain and the mother board, back box of the Flicker as it existed during that time. And 25-B is a later developed printed circuit board version.

The board that's in the Flicker now is the original hand-wired board. We subsequently developed a printed circuit board to plug the Bally Brain into, and that printed circuit board is what's shown in 25-B.

Q But 25-A is the Bally Brain that is actually in Exhibit 333, the electronic Flicker machine in the courtroom?

A Yes.

Q Is that machine, as we see it now and as we examined

it earlier this afternoon, in the same condition in all respects, in all material respects as it was when you completed your work on the machine in September, 1974?

A Essentially, yes; but not in all -- not in all respects.

Q Tell us in what respects it differs.

A Some of the light bulbs were burned out. We replaced them.

Some of the triacs were burned out. The triacs are a type of power device that are used to drive the solenoids specifically. A couple of them were burned out. We replaced those.

21x

Q Did you replace them with substantially the same parts?
A We replaced them with the same parts out of the same bin that we used 10 years ago. We had those parts still in our facility.
Q All right.
A We also replaced the rubbers on the machine. They age and get very brittle, and they all had to be replaced.
Q We will leave further details if counsel cares to go into them on cross-examination, unless the Court has a question now.

THE COURT: No.

BY MR. TONE:

Q But can you say in substance that the machine now in the courtroom is in the same condition in substance as it was in September, 1974?
A Yes.
Q Does that include the Bally Brain?
A Yes, that is the original Bally Brain.
Q Now, we got a little ahead of our story. You had told us where you were in the development process, and we had stopped to discuss the Bally Brain.

At what time was the converted Flicker pinball machine, Exhibit 333, converted into a freestanding machine without the umbilical cord?

When, that is?

A That occurred about three weeks or more before the demonstration; I would say the beginning of September of 1974.

Q At what point was that machine fully functional and operational?

A It was fully functional about a week before the demonstration.

Q Did you do any testing between the time it was free-standing and the time that it was fully operational?

A Yes.

Q What did you do?

A We did a considerable amount of noise testing, and we also, of course, did a lot of performance testing, timing of solenoids and whatnot, and we verified all the functionality, compared identical performance to the original Flicker.

Q Did you test switch scanning at that time?

A We evaluated the performance to make sure that it was the same as the original Flicker, which included, of course, the checking of the switch performance to make sure it operated correctly.

Q What do you mean by noise in this context?

A Well, there are several kinds of noise that we were concerned with. They are all classified as electrical noise, but there is an electrostatic noise, which is the

type of spark you get when you rub your feet across the carpet. There is the electromagnetic type of noise which you get from noisy things like hair dryers on your TV set. We could get that type of noise from the solenoids in the pinball machine itself, for example.

There is also a third kind of a noise, which is a much longer duration noise. It is called bounce. This is the fact that when those switches close, when they get hit hard like with a pinball, that they bounce off of each other for a period of time and generate a series of openings and closings. This is a form of electrical noise, too.

Q Did you in designing your system take into account the kinds of electrical noise you anticipated and design the system to prevent such noises from interfering with its operation?

A Yes, we did.

Q I will come to that more specifically in a few minutes, but for now I would like to ask you what you did in September of 1974 to test your electronic Flicker for noise.

A We did three kinds of testing. The first test was a Van Der Graf generator test. We had purchased a little Van Der Graf generator from Midland Scientific -- it was about 18 inches tall -- and connected a probe to it with a wooden stick to allow us to move it around the game to get sparks from the game at various times. This would

generate electrostatic simulations. This little Van Der Graf generator was basically a piece of material rubbing inside of a globe type of thing, and this would allow us to simulate the electrostatic problems.

We could electrostatically spark the game at different metallic parts to see what would happen.

We also tested it with a Dremmal tool. A Dremmal tool is a drill, one of these little hobbyist type drills. They are very high speed, and they are incredibly noisy.

22-2

Q. Noisy in terms of --

A. Electromagnetic type of noise like you see in your TV set from motor noise.

We found that previously when we had worked on some electronic parts, that if the Dremmal was operating in the area, that it would cause a lot of failures. So we had determined that that was really a good test vehicle for figuring out whether or not we were immune to that type of electromagnetic noise.

Thirdly I had used a gas igniter out of a clothes dryer from my house. I had recently replaced one and had cleaned up the contacts and used that as a form of very severe electromagnetic type of noise generation. It generated a pretty good spark, and it generated noise right back into the AC wiring in the facility.

Q. Were you at that time concerned about noise in the environment in which a pinball machine would be operated?

A. Yes, very much so.

Q. Why?

A. Well, a pinball machine itself is a noise generator, and the electromechanical pinball machines were probably one of the fiercest noise generators we had to worry about with an electronic pinball machine, and they would exist side by side in the same arcade. So that was one type of a thing that we had to be concerned with.

Also several arcades were carpeted and, of course, historically there was a lot of failure on some of the new electronic games of any sort with kids wiping their feet on the floor and touching the coin box and getting free credits. This was a real game with the kids to try to see how many free credits they could get on the electronic games.

If that did occur, of course, the game would become non-functional, basically would not earn any money. So that was something we were very much concerned with.

Q. That is, that would happen if electrostatic noise had an effect on the coin sensing device; it would give somebody a free game?

A. Yes.

Q. Were there any other practical problems that noise would create if it wasn't dealt with in some way in the design of the system?

A. Well, the noise could also get into the other switches and give you extra scoring that you may not be entitled to and may even give you a free ball or other bonus points that you are not entitled to, or it could get into some of the output circuits.

This was a fear that we had, was that a pinball machine is a real current hog, as we talked about earlier, primarily the solenoids. They take many amps of

current, and they are only designed for very momentary duty. If they are on for any extended period of time, they get hot like a toaster. As a matter of fact, it is not uncommon to have them start smoking and actually generate fires.

So with electronic devices, we were concerned that if something were to go wrong and get a noise glitch and the solenoids are turned on, and if they stayed on for an extended period of time, they could start a fire.

Q. Is it also possible that the noise might cause a program to get lost?

A. Now, that was a peculiar --

Yes, it is true, and it was a peculiar problem now to microprocessors that we had not encountered before.

A microprocessor is a program device. If the computer itself gets confused, loses count, it goes to a portion of the program that it is not supposed to be at. It may get locked up there and may not come back.

That type of malfunction in the program can happen from noise as well.

Q. What did you do as well in designing your system to deal with the problem of noise?

A. Well, we did several things. We dealt with the noise at the input level with the switches in a certain way.

Also, we dealt with the noise at an output level, and then also we handled the noise common to both the inputs and the outputs with a third set of solutions.

From the input point of view, the most important thing was to determine whether or not a switch was truly being closed.

Now, noise glitches are very narrow, billionths of a second. They are very tiny. So, therefore, we could just simply sample them twice and determine that the sample was real and not a false noise activation.

Q. Now, can you explain how you would sample them twice?

A. When we are on a particular column, we can read the switches in that column, as I have shown on a previous sketch; but it is important to read the switches more than once.

If you read the switch once, you can determine that there may be a closure, but that closure could be a false indication from this noise spike or this noise glitch.

If you read the switch again, though, some long time -- some time later, and this is not very long -- this is only 20-millionths of a second later.

Now, that does not sound like a very long time, but it is more than enough for a noise because noise only lasts about a tenth of a millionth second, a very short time.

So 20-millionths of a second later the noise will be gone. Then if you read it again and it is still okay, that means it must be a real switch.

So we use double sampling.

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But the sampling was done on a column, and the columns were driving these big power devices like lamps. So to prevent the lamps from causing a problem, because when you first turn a column on, it is like hitting a spring -- it bounces for awhile. There is an electrical bounce that is equivalent to an actual spring-type bounce.

You want to wait for that to settle down. So we did lag sensing, which means that at the last moment in that particular column, you now read the switches -- this is the quietest time where nothing is changed for quite a period of time. Then at that instant in time you can read the switches, and now you can proceed to change the column data to the next column.

Those are the two primary techniques we use for that.

To resolve the bounce --

Q. All right, go ahead.

A. Now, the bounce is a different kind of a problem. This is not in the millionths and billionths of a second, but now we are talking thousandths of a second.

Q. The bounce is different from what you referred to a minute ago as the noise spike?

A. Right.

Q. Before you go on to bounce, would this be a good time to draw on the chart an illustration of a noise spike?

A. Yes, okay.

Q. Would you step down and do that, please?

That is being drawn, your Honor, on Plaintiff's Exhibit 428.

A. A noise spike is, again, a very narrow thing. So if you are looking at a particular switch, the electrical current coming out of the switch, you may see that it is where it belongs most of the time, and then all of a sudden you get a false activation, which gives a very sharp spike.

This can be caused from an electric motor type of interference, and we use the Dremmal tool, but you probably see it at home on something like a hair dryer, on your TV set, that type of a white noise flashing on your TV screen.

Well, that generates a spike like this on the signal wires in a pinball machine.

If you just happen to be reading at that particular instant in time, that can cause you to read a switch that really is not there, the switch was never really closed, but now it read it as closed -- now, the trick is to read it here.

Okay, now we see there is a signal. So we would sense it as a switch closure but then sometime later read it again.

Now, this duration in here is only 20-millionths of a second, so it's a very small period of time from here to here.

But this spike is even smaller. As a matter of fact, they're typically less than a hundred billionths of a second.

Q. Why is it not statistically unlikely that you would be sensing during that very short time space?

A. If you only read once, and with the amount of noise that a motor can generate, it's very likely that you will hit these once every few hundred thousand or million samples --

Q. But you're saying that typically noise spikes are numerous.

A. Yes, there's a variety of these. But they're very narrow. But it's possible that you could hit one of them and sample it.

But the probabilities of seeing it once and then also seeing it on the next adjacent sample are very much slimmer. And so, by double sampling like this, we can determine whether or not the switch closure is actually real.

Q. How fast does the microprocessor count through its programs?

A. It clocks at this rate of about 20-millionths of a second per instruction. So in other words, reading here

and then reading here again would be one instruction separation, or -- it may be 10-millionths of a -- I think it's 10-millionths of a second, but there was an instruction intervening here, so the time between the two inputs was 20-millionths of a second.

Q. How do you describe or characterize the way in which you dealt with noise in that fashion? Is that --

A. Well, statistically what's important here is that we sample the switch twice. So you have to read it first here and then you have to read it again here, and see if the data is still there.

Q. Do you act on the switch at point 1 or point 2?

A. You would act on the switch in this double sampling at point 2. Again, this is only 20-millionths of a second later, so it's not much of a time lag.

You would act on this at point 2.

Q. All right. Does that complete your explanation of noise spikes?

A. Noise spikes, yes.

Q. All right. Now we're ready to discuss bounce.

THE COURT: Well, maybe we'll discuss bounce tomorrow morning.

MR. TONE: All right.

THE COURT: All right. We'll start at 9:30.

MR. TONE: Very well.

(At 5:25 p.m., the within trial was adjourned until 9:30 a.m., January 4, 1984.)